THURSDAY, FEBRUARY 27, 1872

THE GROWTH OF THE STEAM-ENGINE

A History of the Growth of the Steam-Engine. By Robert H. Thurston, A.M., C.E., Professor of Mechanical Engineering, Stevens' Institute of Technology, &c. (London: C. Kegan Paul and Co., 1878.)

WE have before us a very striking instance of the value of a popular knowledge of mechanical philosophy.

The book is essentially divided into two parts. The first six chapters contain a history of the steam-engine as a machine; while Chapters vii. and viii. are devoted to the philosophy of the steam-engine, its history, and application.

As regards the first part we have but little to say. In two points this part of the book is distinctly commendable; the author gives ample reference to the numerous sources from which he has derived his information, and he has cast aside all national partiality. The literature of the history of the steam-engine is now so considerable that it can have been no small task to condense an abstract into something less than the limits of a small volume and at the same time make it interesting; and the success which has been attained must be largely attributed to the excellent illustrations. Much of the matter has doubtless come ready to the author's hand, requiring but little modification. In places the style of the author very closely resembles that of Mr. Smiles. The plan adopted is that of awarding unlimited praise to the various inventors instead of distinguishing between their various claims. Throughout this part of the book little or no attempt is made to explain the physical questions involved or to record the steps by which a knowledge of the physical properties of steam has been acquired.

Had, however, the first six chapters constituted the book, it must have been allowed to pass as a fairly full and very interesting account of the development and application of the mechanism of the steam-engine; much in the same style as the work of Dr. Lardner but in many respects much better and containing considerably more matter.

The history of the philosophy of the steam-engine contained in Chapter vii. might also be allowed to pass, although the assurance with which commendations are distributed to such men as Carnot, Joule, Mayer, Rankine, Regnault, and Thomson could only have been justified by evidence of the possession on the part of the author of a very unusual appreciation of the highest theory of his subject—an appreciation for which the earlier part of the work had in no way prepared us, and which is certainly not shown by the merit of the author's comments in this chapter. These comments, however, are of the most cursory kind, and although for the most part unintelligible, they did not prepare us for the disclosure of the last chapter, in which we have the author's own exposition of the philosophy of the steam engine and its application.

A suspicion that the author's physics are not what they should be began to dawn upon us when we came to the paragraph in which he describes the essentials of a good furnace, which suspicion was strengthened at the following sentence—"A pound of carbon has been found to be capable of liberating by its perfect combustion resulting in the formation of *carbonic oxide* 14,500 British thermal units—" but we still reserved our judgment, as carbonic oxide might be a misprint for carbonic acid. However, on turning over the page we find the following erroneous deduction:—

"The laws of thermo-dynamics teach, as has been stated, that the proportion of the heat-energy contained in the steam or other working fluid which may be transformed into mechanical energy is a fraction, $\frac{H_1 - H_2}{H_1}$, of the total, in which H_1 and H_2 are the quantities of heat contained in the steam at the beginning and at the end of its operation, measuring from the absolute zero of heat motion. In perfect gases,

$$\frac{H_1 - H_2}{H_1} = \frac{\tau_1 - \tau_2}{\tau_1} = \frac{T_1 - T_2}{T_1 + 461{\cdot}2^\circ \text{ Fahr.}};$$

but in imperfect gases, and especially in vapours which, like steam, condense, or otherwise change their physical state, this equality does not exist, and $\frac{H_1 - H_2}{H_1} > \frac{\tau_1 - \tau_2}{\tau_1}$; and the fluid is more efficient than the perfect gas as a working substance in a heat-engine. In any case it is seen that the efficiency is greatest when the whole of the heat is received at the maximum and rejected at the minimum attainable temperatures."

This paragraph shows how completely the author has misapprehended the second law of thermo-dynamics. And this is not nearly all; the theory of the steam-engine is not so simple but that a slip of this sort might have been pardoned, but when we come to the author's application of the theory to the deduction of the economy of the "possible engine of the future," we have page after page of perfect nonsense, which not only shows that the author does not understand what he is writing about, but also shows that his erroneous views of, and imperfect acquaintance with, the theory of the steam-engine have led him into absurd errors from which the earlier inventors on whose work he has so boldly pronounced had emancipated themselves. How far this is the case will appear from the following quotations:—

"Heat-engines may be divided, for present purposes, into three principal classes, according to their disposition of rejected heat:

"I. Those which restore all heat rejected from the working cylinder to the reservoir from which it was derived.

"II. Those which restore a part of the unutilised heat of the working fluid, discharging the remainder from the system and allowing it to be wasted.

"III. Those which waste all heat rejected from the working cylinder.

"No existing type of steam-engine belongs to the first of the classes specified. Some forms of air and gas-engines are theoretically assignable to that class, as, by means of some form of 'regenerator,' they store up rejected heat and restore it to the succeeding charge of working fluid as it enters the cylinder. . . .

"There are two forms of engines of Class I., in which—were it possible to fully avail ourselves of them—all this waste of energy may be avoided:

"Type A. The working fluid, if expanded from the temperature and pressure of the boiler or reservoir quite down to the absolute zero, would have all its heat-energy transformed into mechanical work, and there would be no waste. The efficiency would be perfect.

"Type B. All heat rejected from the cylinder unutilised may be gathered up and restored to the boiler, there to serve as a basis upon which to pile a new stock of transformable heat-energy, instead of being, as now, rejected from the system entirely and lost. This done, there could be no loss, as all heat leaving the machine would be transmitted to exterior bodies as mechanical energy. Nothing being lost as heat, the efficiency of the engine would be unity and its economy a maximum.

"Forms of steam-engines may be conceived in which these methods (of saving heat now wasted) may be applied. Practically, however, it is evident, the first form of these two ideal engines can never be made successfully, since it would require to be made of such immense size that all the power derivable from it would be insufficient to move it."

An instance of the Type B is given. It is proposed to expand the steam in the cylinder until it is half liquefied, then separate the water from the steam and return them separately to the boiler, whereupon it is concluded.

"Under the conditions now assumed, it is evident that only that portion of the heat entering the engine which is surrendered by the condensation of steam doing work can be utilised. It is also evident that, in this form of engine, no heat can be lost; and, consequently, that the engine of Type B, which is operated as just indicated, will have yielded the exact equivalent of the net amount of heat expended upon it. *All heat rejected from the working cylinder, unutilised, being returned to the boiler*, there to form 'a basis on which to pile up a new stock of utilisable energy,' the engine is a 'perfect engine' in a broader sense than that adopted by Carnot. It is further evident that perfect efficiency is given for all ranges of temperature, and that what working fluid shall be adopted, and what temperatures shall be chosen, will be determined simply by practical conditions to be ascertained by experiment. . . .

"When this possible 'engine of the future' is likely to be introduced, if at all, can be scarcely even conjectured. It seems evident that its success is to be secured, if its introduction is ever attempted, by the adoption of high steam-pressures, of great piston-speeds, by care and skill in design, by the use of exceptionally excellent materials of construction, by great perfection of workmanship, and by intelligence in its management. There seems no tangible obstacle to its introduction." [1]

KINAHAN'S GEOLOGY OF IRELAND

Manual of the Geology of Ireland. By G. St. Kinahan, M.R.I.A., &c. (London: C. Kegan Paul and Co., 1878.)

THE appearance of another volume on Irish Geology, so soon after that of Prof. Hull, seems to show that the geologists of the Emerald Isle can be as active with their pens as with their hammers. Mr. Kinahan, indeed, has just claims to be heard when he treats of the rocks of his native country, for we suppose there is hardly any other living Irishman who has worked so long and so continuously among them. His volume, of course, coming before us as it does, cannot but challenge comparison with that of his director, Mr. Hull; and in truth it would almost appear as if this had been, consciously or not, in his mind. The two books, however, are on two very different plans. The general reader who wishes a pleasantly-written sketch of Irish geology, and of its relation to the scenery of the island, will find what he needs in Prof. Hull's chapters. Mr. Kinahan's work is more suited for professed geologists who propose to visit Ireland, and want to have some idea of the best districts to visit for their special purpose.

The volume is divided into five sections. In the first the author describes the sedimentary formations of Ireland, going over the country district by district, and pointing out in a useful, if somewhat prolix manner, the peculiarities of each. In the second he enters upon more speculative matter in an account of metamorphic and eruptive action as displayed among the Irish rocks. The third is devoted to the superficial accumulations, including the drift, the proofs of glaciation, changes of level, peat-bogs and prehistoric remains, and extinct mammalia. In the fourth section a brief description of the physical features is given from the writer's own point of view. The remaining division treats of the economically useful minerals of the country.

One cannot read Mr. Kinahan's pages without recognising his sturdy force of character. He takes up a position and holds it, one might almost think sometimes against his better judgment. It is satisfactory, however, to find him willing to yield sometimes, as, for instance, in his relinquishment of the absurd *yte* termination of rocks, though he takes care to inform us that while he yields to the entreaties of publishers and friends, he remains of the same opinion still. What a labour it must have been originally to change all his i-s into y-s! There are some other matters of orthography or even of grammar, which, when he feels himself to be in a compliant temper, he may take into his consideration. Why does he so constantly speak of "Cambrians" and "Silurians?" These are adjectives, and not nouns, and though in the field-slang of the Geological Survey, or of geologists generally they may be tolerated, they ought not to appear in any grave published work.

In the first section of the book it will probably occur to most readers that there is a want of breadth in the treatment of the subject. The local details are valuable as guides to the places and for the scattered facts they contain. But they lack that connecting thread which would have strung them all together and have carried the reader intelligently along, instead of leaving him, as he can hardly help feeling, struggling after the seven-leagued strides of Mr. Kinahan as he hops from district to district. Brief summaries for the separate regions, and a general connected summary of the whole for the system or formation, would have given the reader the key to the details. And as regards these details we fear they are often too vague to be of as much service to the field-geologist as he would wish them to be. The kind of detail he needs is supplied by the valuable "Explanations of the Geological Survey of Ireland." Mr. Kinahan often, indeed, refers to these "Explanations," but he would have given his volume a more practically useful character had he inserted in the account of each district a reference to the particular explanation in which a fuller description may be found. Such references, for the purposes of the student and the geologist who wants to study the matter on the ground, cannot be too precise and frequent. As it is, Mr. Kinahan's chapters on the rocks and struc-

[1] "The idea first suggested itself to the mind of the writer in 1858–59, when at Brown University, and while designing a peculiar form of 'drop cut-off engine,' which was intended to work with exceptional economy. The plans then conceived have gradually assumed a different shape, but still embody the essential principles here outlined. Mr. C. E. Emery, in 1868, proposed a similar plan."

ture of Ireland are full of suggestive matter, and will be consulted by all who wish to learn what has been done in Irish geology.

The section which will provoke most criticism is, no doubt, the second—on Metamorphic and Eruptive Rocks. The author himself hints something to this effect in his preface. There are objections to the terminology he has invented, the words themselves being unfortunately selected. For Daubrée's term "regional metamorphism" he substitutes *metapepsis*, and, speaks of *metapeptic* rocks. A dyspeptic geologist—and we suppose such beings exist in some number—will shudder at the very sound of these words. Then the old term "contact metamorphism," long ago so elaborately illustrated by Delesse, is replaced by *paroptesis*, and its rocks are called *paroptetic*. Another term, *methylosis*, is applied to a local kind of metamorphism, "due to the introduction and action of chemical substances from without;" and the rocks affected by it are named *methylotic*—a word which many a learner will at once surmise to be connected in some way with the methylated spirit he used to spill and smell of in the days of his practical chemistry.

But accepting these terms, there will be graver objections to some of Mr. Kinahan's metamorphic notions. It is specially unfortunate that he does not give any adequate grounds in this volume for enabling the reader who has not perused his other writings to judge on what detailed evidence his conclusions have been based. For example, he treats quartz-rock as one of the intrusive granitic rocks, and distinguishes it from quartzite or quartz-schist. But we have been unable to discover any passage which explains how he could distinguish these rocks, and what are their relative mineralogical and petrographical characters. Nay, while in one place he includes quartz-rock among the highly siliceous intrusive granitic rocks, he elsewhere speaks of it as having been again and again deposited by springs connected with volcanic action. Surely he does not wish us to believe that even a tyro in petrography would confound siliceous sinter with any form of granitic rock? Again, without giving any data, he speaks of "protrusions of limestone and dolomite." How does he imagine they were protruded? Were they thrust out as solid masses, or like the quartz-rock of his springs? He mentions them in connection with "a sheet of quartz-rock," and speaks elsewhere of having himself observed intrusive quartz-rock in many places. It is evident, however, that it would lead to the most hopeless confusion if the term quartz-rock, which has for generations included hardened siliceous sandstones, sometimes even with traces of organisms, were applied also to any member of the granitic family. Mr. Kinahan should invent another name for his intrusive quartz-rock. He has no timidity in names, and might hit upon one quite as euphonious as those already referred to.

Probably the most valuable part of the book is that which treats of the prehistoric remains. Mr. Kinahan is an authority on *crannoges;* and the digest therefore which he has given of known facts in this subject, besides its interest to the general reader, will be welcomed by geologists to whom the scattered papers in the Transactions of the Irish Societies are not familiar.

The illustrations are singularly poor, and seem all the more so by contrast with the sketches of the lamented Du Noyer, which have made the geology and scenery of Ireland familiar to many eyes all over the world. Could not Mr. Kinahan have availed himself of some of the drawings, published or unpublished, of his friend? Any additional publicity he could have given them would have been another tribute to the memory of a true artist.

While the author recognises the debt of gratitude owed by Irish geologists to Griffith and Jukes, there are some names which he passes over in strange silence. Why, for instance, could he find no room for the honoured name of Harkness? Surely, when he was writing about the metamorphic rocks of Donegal, he might have made grateful allusion to the geologist who, more than any one else, has thrown light upon these rocks. He quotes two or three times an opinion of Prof. Hull only to reject it, and these are all the direct references he deigns to make to the labours of one who has already done and is still doing so much for the cause of Irish geology; there being not the least allusion anywhere to the previously published volume by that writer. This may have arisen from mere inadvertence, and in that hope we take leave of Mr. Kinahan and his book, wishing for both that appreciation from geological readers which they deserve.

OUR BOOK SHELF

Studies in Comparative Anatomy. No. I. *The Skull of the Crocodile.* By L. C. Miall. No. II. *Anatomy of the Indian Elephant.* By L. C. Miall and F. Greenwood. (London: Macmillan and Co., 1878.)

PROF. MIALL has given in the first of these "Studies" a careful and systematic description of the Skull of the Crocodile, his object being to furnish to students a more complete account of the skull in this family of reptiles than is found in the usual treatises on the Comparative Anatomy of the Vertebrata. He commences by giving a general view of the crocodilian skull, and then sketches its mode of development, pointing out at the same time the relation of the cranial nerves to the post-oral clefts and arches. The individual bones of the skull are then described in detail. An elaborate account is given of the tympanic cavity and of its communications with the several Eustachian passages, which, together with the external auditory meatus, represent the cleft between the mandibular and hyoidean arches. Mr. Miall gives in an appendix a translation, with annotations, of Rathke's account of the development of the skull of the crocodile. The essay will be of great service to those desirous of acquiring a knowledge of the crocodile's skull.

In the second of these "Studies" Prof. Miall writes, in conjunction with Mr. Greenwood, an account of the anatomy of the muscular, vascular, digestive, and genito-urinary systems of the Indian elephant, together with some observations on the organs of special sense. This essay appeared originally in the *Journal of Anatomy and Physiology* for 1878, and in reprinting it the authors have reproduced the plates and woodcuts employed in illustrating their description as it appeared in that *Journal*. Throughout the essay frequent reference is made to the previous literature of the subject, and the authors point out any discrepancies between their observations and the descriptions of the other anatomists who have examined this species of elephant. The part of this essay which contains the greatest number of new facts is the description of the muscular system, which is very carefully done, and forms an important contribution to the myology of this huge animal.

Seconda Contribuzione morfologia e sistematica dei Selachi. Del Prof. Pietro Pavesi. (Genoa, 1878.)

IN 1874 Prof. Pavesi, of Pavia, described in the *Annali del Museo Civico* of Genoa a shark which had been captured at Lerici, in the Gulf of Spezzia, in 1871. It belonged to the genus *Selache*, but, from a peculiarity in the conformation of the rostrum, Pavesi considered it to be a distinct species from the great basking shark, *Selache maxima*, and named it *Selache rostrata*. The specific difference of this specimen has, however, been called in question by Canestrini, Steenstrup, and other ichthyologists, who were inclined to regard it as a monstrous form of the *Selache maxima*. In June, 1877, a male shark, also belonging to the genus *Selache*, was caught in the harbour of Vado, near Savona, and, being examined by Prof. Pavesi, forms the subject of this second communication to the *Annali del Museo Civico*, vol. xii. Its length was between ten and eleven feet. It had been eviscerated before coming into his possession, so that the memoir does not give an account of the abdominal viscera, but the external characters, the skeleton, the pectinated appendages, the brain and cranial nerves, and the vascular system, are described. The shark from Vado is almost identical, says the author, with that previously caught at Lerici. He then carefully reconsiders the systematic position of these specimens. He is strongly of opinion that the view that the specimen originally described was a monstrous form of *Selache maxima* is quite untenable. But his examination of this second specimen has convinced him that these sharks can no longer be regarded as a distinct species, and that they are young examples of the great basking shark, *Selache maxima*. The memoir is illustrated by a lithographic plate and by twenty-seven woodcuts.

Das Leben. Naturwissenschaftliche Entwickelung des organischen Seelen- und Geisteslebens. Von Philipp Spiller. (Berlin: Stuhr'sche Buchhandlung, 1878.)

THIS work may be said to be but an enlarged reproduction of a division of an earlier and more important work: "Die Urkraft des Weltalls nach ihrem Wesen und Wirken auf allen Naturgebieten," by the same author. Prof. Spiller, whose death it was our painful duty to announce last week, is the originator and founder of a philosophical theory on the first cause of all things. According to his view the world-ether is the architect of the universe as well as the fundamental cause of gravitation. In his works, particularly in the one just mentioned, the learned professor treats this world-ether theory in a most masterly manner, and whatever view we may take as to the correctness of his views—a question which we certainly do not wish to decide—it is only justice to point out that his explanations and definitions are all written in such a spirit of firm conviction of the truth of his theory, that an attentive reader cannot refuse his admiration and respect.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Leibnitz's Mathematics

I UNDERSTOOD Dr. Ingleby to say that he was prepared to make good his assertions, and to respond to Mr. Nelson's "call" as soon as I retracted, or justified, my former statement.

In 1871 Dr. Ingleby said it was exactly twenty years since the last vestige of presumption against the fair fame of Leibnitz was "obliterated."

Dr. Ingleby is evidently unacquainted with the work of Dr. Sloman (Leipzig, 1858; in English, Macmillan, 1860), else he would not have spoken of the "last vestige of presumption."

Kant's opinion of Leibnitz, which is *far more favourable* than that of Dr. Sloman, compares him to chemists "who gave themselves out to be possessed of secrets, when they had really nothing but a persuasion and a conviction of their capacity for acquiring such." This verdict, from a *true* metaphysician, ought to have much weight with Dr. Ingleby. P. G. TAIT

Guthrie's "Physics"

SOME weeks ago (p. 311) you published in NATURE a review by Prof. Maxwell of a little book of mine on Practical Physics. It is not my intention to complain in any way of the review, partly because it would be a profitless trespass on your space, but mainly because, while the tone is unfavourable, the instances adduced by the reviewer go a long way to confute his own statements in all cases where there is any connection between the two.

Some well-meaning friend has composed and sent me a copy of the inclosed. There appear to be various opinions as to the authorship. It has even been suggested that Prof. Maxwell, with that sense of humour for which he is so esteemed, and with a pardonable love of mystification, is himself the author.

February 24 FREDK. GUTHRIE

REMONSTRANCE TO A RESPECTED DADDIE ANENT HIS LOSS OF TEMPER

Suggested by Prof. CLERK MAXWELL'S *review of* GUTHRIE'S "PHYSICS"

WORRY, through duties Academic,
It might ha'e been
That made ye write your last polemic
Sae unco keen:

Or intellectual indigestion
O' mental meat,
Striving in vain to solve some question
Fro' "Maxwell's Heat."

Mayhap that mighty brain, in gliding
Fro' space tae space,
Met wi' anither, an' collidin',
Not face tae face.

But rather crookedly, in fallin'
Wi' gentle list,
Gat what there is nae help fro' callin'
An ugly twist.

If 'twas your "demon" led ye blindly,
Ye should na thank him,
But gripe him by the lug and kindly
But soundly spank him.

Sae, stern but patronising daddie!
Don't ta'e 't amiss,
If a puir castigated laddie
Observes just this:—

Ye 've gat a braw new Lab'ratory
Wi' a' the gears,
Fro' which, the warld is unco sorry,
'Maist naught appears.

A weel-bred dog, yoursel' must feel,
Should seldom bark.
Just put your fore paws tae the wheel,
An' do some Wark.

$$d\sqrt{\frac{m}{n}}.$$

Unscientific Art

IN *Punch's* series of cartoons, "the man at the wheel" turns up now and again. The most recent example is that of date February 22: John Bull and Punch are strenuously holding a steering-wheel between them, in a tempestuous scene. I have a second example before me in the series of cartoons of Beaconsfield recently issued, No. 61: Disraeli has one hand on a steering-wheel, while the other holds a pistol directed to the powder magazine below; and he threatens to blow up the ship if Gladstone and Bright (climbing over the bulwarks behind) step on board. Other cases will be remembered. Now (neglecting here the political meaning of the pictures) these steering-wheels are wonderful productions, and how they serve for steering is a mystery. The wonder, remarked on by St. James, of "a very small

helm" turning great ships, is here outdone. The wheel stands, in all simplicity, between two uprights, or a slitted upright, fixed on the deck (or a raised platform); there is nothing behind or before the outer surfaces of the uprights. But an essential part of ordinary steering-wheels is the drum or axle extending generally a little way behind (and covered, it may be), on which are wound ropes or chains passing round pulleys to the tiller. A more modern form well known is a screw shaft with levers, &c. The omission in question in these cartoons leaves the scientific mind decidedly "at sea," and with little confidence in the steersman. I suspect the artistic type of mind is rather apt to neglect such details.

It is remarkable, indeed, how many matters belonging to simple observation escape notice by artists. I may perhaps be allowed to note a few points which have occurred to me in glancing over *Punch* from November to the present time, and the three books of cartoons of the *Punch* series.

The electric machine sometimes makes its appearance in *Punch*. In No. 53 of the Beaconsfield cartoons, that gentleman (as a professor) is arranging a circuit between an aristocrat and a working man for a shock. The electric machine behind is evidently meant for one of the Ramsden type, but the brass-work with points to collect the electricity is wanting, and the glass plate seems to have great concealing power. Again, the clever and fantastic sketch at the beginning of the Almanack shows an electrical machine of quite indescribable type, unless it be a Holtz, but it defies all mechanical conception. Perhaps it is not allowable to apply scientific rules to the brilliant insanity of such drawings, but I think there should be more basis of real existence than this one presents.

From many pictures we might be led to infer that left-handedness is much more common than it really is. Thus, a *pince-nez* is held in the *left* hand by Mr. Bright (in No. 19 of the Bright cartoons); by a church dignitary speaking to his daughters (*Punch*, December 21, p. 282), and by an old gentleman who receives a letter on the road on a snowy day (*Punch*, February 1, p. 39). In the Almanack (p. 5) a workman holds a cup in his left hand and a saucer in his right. Reins are frequently held in the right hand (which, I understand, is wrong)—one example is the cartoon of *Punch*, December 14, "Post Equitem." If something might be said for these cases, it is difficult to see how an artist can be justified in putting a quill pen behind the *left* ear, as in the case of Gladstone, when meeting Bismarck (last of Gladstone series), unless, indeed, the right ear were already occupied with one (which is not here the case). A similar remark seems applicable to a caricature of Ruskin by Sambourne (*Punch*, December 7, p. 254).

In an ingenious sketch (*Punch*, February 1, p. 37), in which a complex pocket-knife or sort of *multum in parvo* is made to take the aspect of a formidable animal, the spiral of the cork-screw turns the wrong way.

In one of the Bright cartoons (No. 33), that gentleman appears in court costume before a mirror which slants away from him upwards, but the image, I think, hardly corresponds to this.

One word more, and of a somewat different order of criticism. Heat of certain intensities and in certain circumstances may, of course, be very unpleasant. But, as we have had good reason to know lately, heat may be very welcome and agreeable. Therefore I venture to indict the cartoon of *Punch*, February 15, "Hot water, sir!" as flagrantly at fault. Beaconsfield is bringing in the morning's hot water to John Bull in bed. In the session of 1879 John Bull may very likely find himself "in hot water;" but in the connection to which the picture refers, hot water is a pleasant mitigation to the inevitable discomfort of washing. So John Bull's horrified look could not possibly refer to that. If he were being awoke, as I have been, in a hydropathic establishment, about 6 A.M., by a fiend in human shape, who showed a cynical determination to pack him in a cold wet sheet, the man's implements *might* arouse some horror. In the Beaconsfield cartoon, No. 90, "The Turkish Bath," the metaphor is, of course, all right: "You made it so confoundedly *hot* for me!"

Some of the foregoing are little points, but they prove this much, that there is room for improvement among artists of this class as regards correctness of observation and strict fidelity to fact.

A. B. M.

Intellect in Brutes

In Mr. Nicols' instance of intellect in brutes (NATURE, vol. xix. p. 365) he tells us that a plumber "had on several occasions been called in to examine into the cause of leakage of water-pipes under the flooring of houses," and then records *a single instance* of rats having knawed through a pipe. It is important to know whether the plumber knew of another case: for the idea at once suggests itself that the pipe had cracked through frost, and the rats then discovering the leakage gnawed it to get more water.

It has always seemed to me that brute reasoning is always *practical* but never *abstract*. They do wonderful things suggested by the objective fact before them; but, I think, never go beyond it. Thus, a dog left in a room alone rang the bell to fetch the servant. Had not the dog been taught to ring the bell (which on inquiry proved to have been the case) it would have been abstract reasoning, but it was only practical. The Arctic fox—too wary to be shot like the first who took a bait tied to a string, which was attached to the trigger of a gun—would dive under the snow and so pull the bait down below the line of fire. This is purely practical reasoning; but had the fox pulled the string first out of the line of fire *in order* to discharge the gun, and *then* to get the bait, *that* would have been abstract reasoning which he could not attain to.

This practical reasoning is just what young people do, before they can reflect. A boy the other day found the straps of his skates frozen. The fact only suggested *cutting* them. Not one of his schoolfellows reflected upon the abstract fact that the ice would melt if he sat upon his foot a few minutes. Hence brutes and boys are just alike, in that nothing occurs to either beyond what the *immediate* fact before them may suggest. The one kind I call purely *practical* reasoning, which both have; the other, *abstract*, which brutes *never* acquire; but the boy *will* as his intelligence develops.

GEORGE HENSLOW

In Central Park one very hot day my attention was drawn to the conduct of an elephant which had been placed in an inclosure in the open air.

On the ground was a large heap of newly-mown grass, which the sagacious animal was taking up by the trunkfull, and laying carefully upon his sun-heated back. He continued the operation until his back was *completely thatched*, when he remained quiet, apparently enjoying the result of his ingenuity.

It seems to me that *instinct* should have prompted the elephant to eat the grass, and that it was *reason* which caused him to use it for the purpose of diminishing the effect of the sun's rays.

New York, February 8 JAMES J. FURNISS

Bees' Stings

Will you allow me, as possessor of a couple of score of hives, to say a word respecting the discussion in your columns as to the effect on *Apis mellifica* of the loss of its sting and appendages.

As far as my observations go, the bee is not seriously injured by the loss, for though imprisoned and watched for some hours, as soon as released it flies back to its hive, and apparently resumes its work as before. However, any one sufficiently painstaking can settle the question finally by marking some such bees, and watching for their departure, and return laden with honey or pollen.

May I ask if any of your readers have yet determined the identity of bee poison and formic acid. The former is said, on exposure to the air, to solidify to a white crystalline mass, but formic acid requires, I believe, a temperature of 0° C. to effect this modification.

J. P. JACKSON

Bull's Mill Apiary, Hertford, February 18

P. LE NEVE FOSTER

A VERY numerous body of friends will have heard with regret of the sudden death of Mr. Le Neve Foster, the secretary of the Society of Arts. Though not himself an original worker in science, there were few men better known in scientific circles, or so universally liked where he was known, as Mr. Foster. His connection with the Society of Arts threw him amongst men working in nearly all lines of research, and there are probably few recent instances of the practical application of any new scientific discovery to industrial purposes in which he did not take some interest. Coming up to London with a fellowship from Trinity Hall, he was called to the bar in 1836, and practised for some fifteen or sixteen years

as a conveyancer. The natural bent of his mind, and some association of his relatives with the Society of Arts, led him to join it, and he soon became a member of its council. The Society was then in anything but a flourishing state. The necessity for such work as it had usefully done at the beginning of the century had passed away, and those who then controlled its destinies were hardly capable of striking out for it a fresh line of action. It was, however, just beginning to revive a little, when the proposal to hold the first great exhibition was taken up by Mr. (now Sir) Henry Cole, Mr. (afterwards Sir) Wentworth Dilke, and some others of the more enterprising spirits who were then gaining the upper hand in the Society. With this reforming party Mr. Foster was associated, and it tells much of the character of the man, of his freedom from self-seeking tendencies, that while other members of the little body worked their way upwards to honours and high positions, he was content to remain without reward, either pecuniary or titular, as a worker for the whole of his life. When Mr. Grove gave up the secretaryship of the Society of Arts in 1853, Mr. Foster, resigning the post he then held on its Council, was appointed to the office, an office which he held till the day of his death, last Thursday. Since then his career has been associated with that of the Society. This grew in numbers and influence, and so the Secretary's office increased in importance. During the twenty-five years in which he guided it, it did a great deal of good work, and, it may be owned, some which was not of much value. The trivialities soon passed away and were forgotten, the good work endures. In undertakings such as that of a public society most of the work and but little of the credit falls to the executive officer, and probably, if the truth were known, many of the crude ideas first launched into the world at the Society of Arts owed their ultimate success to their having been hammered into a practical form by the secretary. Ever ready with advice, the fruit of long experience, never bored even by the most importunate of inventors, ready to find something good, something to praise in the most impracticable of schemes, he won the friendship, even the affection, of all who knew him.

At many scientific gatherings his genial presence will be missed. His was a well-known figure at the British Association meetings. For thirteen years he acted as secretary to Section G (Mechanical Science), and from 1863 to 1866 he served on the Council of the Association. Taking an intelligent interest in several branches of science, it was to photography that he principally devoted himself. He was one of the earliest amateur photographers, and continued to work energetically at his favourite pursuit down to the time of his death. One of his last bits of out-door work, before his camera was laid aside for the winter, was to take a view of the Obelisk on the Embankment, a day or two before it was swung from a horizontal into a vertical position. He wrote a good deal on photographic subjects, mainly in the pages of the *British Photographic Journal*, and similar periodicals. He also wrote the article on photography in the series of volumes on "British Industries," published by Mr. Stanford. He was an occasional contributor to several of the scientific and technical journals, and wrote a good deal in the *Journal* of his own society, which, though not founded by him, was published from the beginning under his auspices, for he was on the Committee of Publications when it began, and his secretaryship commenced before the completion of its first volume. The older series of *Transactions*, it will be remembered, ceased some few years before the *Journal* was started. Mr. Foster was one of the founders of the Photographic Society, and served till a few years ago on its council. He was also President of the Queckett Club for a year. The manner of his death was startlingly sudden. Returning home after his day's work, he sat down to read the newspaper before dinner, when one of his family coming into the room after he had been by himself only a few minutes, found that he had fallen back from his chair dead. The cause of death was fatty degeneration of the heart. He died as we might all wish to die, at a ripe old age (nearly seventy), quietly and easily, after a good life's work, and in harness till the end.

He did not live to receive a testimonial which his friends had just collected for him, and these same friends now propose to do what they can to increase the amount for the benefit of those he has left behind.

DR. APPLETON

WE were only able last week to note briefly the loss which learning and science have sustained in the death of Dr. Appleton at the early age of thirty-eight years. Dr. Appleton was born at Reading, where, and at St. John's, Oxford, he received his education. His special bent lay more in a literary and philosophical than in a scientific direction; but, as we indicated, his services to the advancement of science in this country have been very great. He may, indeed, be regarded as the originator of the movement for the endowment of scientific research; and it is greatly owing to his unceasing activity and influence that anything has been done in this direction by Government. To quote the words of the memoir in the *Academy*, of which he was the founder, and which, for the sake of sound criticism and accurate knowledge, we trust will be a lasting monument to his energy, and the breadth of his culture:—"With an enthusiasm which nothing could chill, and a belief no opposition could shake, he endeavoured to inspire his countrymen with the same zeal for learning and science that he felt himself, and to rekindle among them the well-nigh extinguished love of disinterested study and research. Where others talked, he acted; where others wavered, he continued firm. Through good report and evil report he struggled on towards the goal he saw clearly before him, and the confidence he felt himself was communicated to those who worked with him. Gifted with the power of organisation, with boundless energy, and with the art of influencing others, he was marked out as the leader of a forlorn hope. Defeat was impossible for him, and disappointment only increased his courage and activity. It was in Dr. Appleton's hands that the movement in favour of the endowment of research took solid shape and organisation. His exertions brought about the meeting at the Freemasons' Tavern in 1872, which first drew public attention to the fact that the universities exist for something higher than the examination of young men. From that time forward Dr. Appleton took an active share in the agitation that resulted in the passing of the Universities Act of 1877, and none of the opportunities which his editorial position gave him were allowed to be lost. Besides letters in the *Times*, the *Pall Mall Gazette*, and elsewhere, he wrote two elaborate articles on 'The Economic Character of Subsidies to Education' and 'The Endowment of Research as a Form of Productive Expenditure,' both republished in the volume of 'Essays on the Endowment of Research,' of which Dr. Appleton was editor."

We are pleased also to be able to refer in this connection to an article in the *Athenæum*. Although there are some parts of this article which we certainly could not quote. In this it is acknowledged that Dr. Appleton had raised a great question, and given it a hold on public interest, "and there can be no doubt that the movement which he, more than any other single man, had set on foot had considerable effect on several of the provisions of the Universities Act passed by the present Government." . . . "For a man who died before he was thirty-eight it is no slight achievement to have forced such a question as this on the sluggish attention both of the public and of Parliament."

We are pleased not only that our contemporary should bear such hearty testimony to the energy and success of Dr. Appleton, in promoting the cause which he had at heart, but that it should be able to refer to the subject of endowment of research not only without bitterness, but with even some slight measure of approval. A cause which had so pure-minded, clear-sighted, and widely-cultured a man as Dr. Appleton on its side, must surely have some solid reasons in its favour.

Dr. Appleton is acknowledged by all who knew him to have been one of the most even-tempered of men. He was always cheerful and complaisant; opposition and even rudeness did not ruffle him; he returned to the charge smiling at every blow. He was a very quick and ready manager in such work as that of an editor, being full of suggestion, and prompt at meeting difficulties. He was a genuine philosopher, though he professed keen interest in all departments of knowledge, he did not make the mistake of over-estimating his own knowledge, or of pretending to an encyclopædiac mind. His great merit is that he really gave time and strength for "ideal" ends.

PRISON BREAD

IN two former papers[1] I discussed the dietetic value and chemical composition of brown bread and of aerated bread. The recent report[2] of the Committee appointed to inquire into the dietaries of the prisons in England and Wales having called public attention to the subject of the nourishment contained in different varieties of bread, the suggestions made in that report may be suitably considered at the present time.

On pages 21, 22, 23, 38, and 39 of the report will be found the statements and figures as to the bread question, which I propose to criticise on the present occasion. The committee begin by stating that "the flesh-formers in white bread amount to 7 or 8 per cent., according to the quality of the wheat of which it is made. In bread containing the envelopes (of the grain) they amount to about 10 per cent." Two or three years ago little fault could have been found with these statements; indeed, the Committee appear here as in other parts of their report, to have drawn some of their facts and figures from a work of my own on Food, published in 1876 for the Science and Art Department. Still I am not now prepared, in the light of the most recent analyses of wheat and its mill-products, to endorse the statement that brown bread, whether made so as to include all the flour, middlings, sharps, pollard, and bran, produced from a given weight of wheat, or with all these materials minus the coarse bran, will contain on the average 10 per cent. of flesh-formers. Why, there are some varieties of wheat, beautiful, plump, soft, white, floury wheats, which do not contain more than 8 per cent. of total nitrogenous matters of all kinds, including veritable flesh-formers. How then can a wheat of this kind, if simply ground up (whether the 4 per cent. of long bran it yields be included in or excluded from the bread), be made to yield a brown bread or whole meal bread containing more flesh-forming matter than 5½ per cent.? For the meal will have taken up nearly one half its own weight of additional water, and will now be proportionately more dilute as to all its nutrients.

And, again, I have previously pointed out that the coverings of the wheat grain contain, in varying, yet considerable proportions, nitrogenous compounds to which the flesh-forming property cannot be rightly attributed. Thus, it may easily happen that the inclusion of the 14 or 15 per cent. of mill products, usually rejected in bread-making (excluding the long bran), may not appreciably influence the proportion of flesh-formers in the loaf. These two considerations do not, in my opinion, lessen the desirability of substituting whole meal bread for white bread in our prisons, but they invalidate some of the Committee's calculations as to the amounts of flesh-formers supplied in the new prison-dietaries, and they further suggest a method of adjusting the nutrient ratio which should subsist between the nitrogenous and carbonaceous constituents of the day's ration. I will briefly discuss these two points.

We are told (on page 38) that 7 lbs. per week of bread will furnish the prisoner with 9·072 ounces of flesh-formers. Now, if the bread referred to be that recommended by the reporters, 7 lbs. should furnish, according to their own showing, no less than 11·2 ounces of flesh-forming nitrogenous matters. For they affirm such bread to contain on the average 10 per cent. of flesh-formers, and so the weekly allowance of 7 lbs. or 112 ounces of bread would furnish 11·2 ounces of these nutrients. They appear, however, to have assumed the bread in use to contain not 10, but only 8·1 per cent. of flesh-formers—at least, in the absence of direct analytical data, I deduce this figure from the calculated amounts of nitrogenous substance tabulated in the report. Indeed, I conclude that they have not made the fresh calculations rendered necessary by the altered composition of the proposed bread, but have adopted the old figures of Playfair and other writers on this subject. But taking average whole meal bread made as directed by the reporters, and from ordinary wheats, it would not be safe to reckon upon it containing as much as 8·1 per cent. of true flesh-forming material—my own experiments put it at a little above 7. But granted the higher figure, we then find that the prisoners with hard labour (with 7 days' confinement) receive no more than 14 ounces of flesh-formers to 96 of heat givers, reckoned as starch, during a week. The ratio here is 1 to 6·8, which differs too widely from the normal ratio (1 : 4½) to afford satisfactory sustenance to men expected to do hard work.

There are, however, two ways out of this difficulty. Why should not a part of the fine flour be excluded from the constituents of the meal for prison bread? Or again, why should not biscuit flour, tailings, and middlings be added to it from other sources? And the same result might be ensured, and the flesh-formers be at the same time more adequately represented in the bread, if care were taken to choose for prison meal the hard, horny and tail wheats, which are always more nitrogenous than the white, opaque and soft grains. It is true that some of these hard, translucent wheats, especially when they owe their character to unripeness or a wet season, contain a larger proportion than usual of non-albuminoid nitrogen, but in spite of this their percentage of true flesh-formers is always high. It would be quite easy, by chemical analysis of the samples of grain offered by contract to the authorities, always to secure a wheat containing 13 to 14 per cent. of true flesh-formers, and therefore capable of producing a bread with at least 9 per cent.

There are two other remarks suggested by reading the part of this report on Prison Dietaries which relates to bread. The Committee is clearly right when it urges the desirability of including most of the coarser mill products of wheat in the meal on account of the phosphates thus secured. And the proposed plan is a good one, of making the dough of the finer mill products only at first, and then introducing, when the dough is nearly ready for the oven, the middlings, sharps, and pollard; again, kneading the mass as quickly as possible, and then baking it. The excessive solidity and stickiness of most whole meal bread is thus avoided, since the ferments present in the seed coats of the grain have but little time to exert their action upon the starch of the flour. A. H. CHURCH

[1] NATURE, vol. xviii. p. 229, and vol. xix. p. 174.
[2] Report of Committee on Dietaries in Prisons, 1878.

ISOMORPHISM

AT the regular meeting of the Berlin Chemical Society on February 10, Prof. Hermann Kopp, of Heidelberg, delivered an address upon "Isomorphism." Prof.

Kopp first proceeded to sketch the methods employed for determining the molecular and atomic weights of the elements. When an element can be volatilised conveniently, so that we can obtain its vapour-density, its molecular weight is readily decided. Those elements which enter with a large number of volatile, or gaseous bodies, like carbon, present but little difficulty. Those, like zinc, which form but one class of volatile compounds, leave much to be desired, for a series of homologous bodies are no better than a single member of the series. In this case, however, the specific heat of the element comes to our aid, and we can usually take such a multiple of its equivalent as will give, when multiplied by the specific heat, a product not far from six. Naumann's law also enables us to make use of the specific heat of salts as well as that of the elements, the product of the specific heat by the sum of the atomic weights being nearly equal for similar compounds, and usually six times that of the number of atoms in a molecule. But this fails in some cases, probably, because we cannot take the specific heat at a sufficiently high temperature, as in the case of ice. In many cases where the above tests fail, isomorphism holds good. But totally unlike bodies, containing an unlike number of atoms in the molecule, have the same crystalline form. To avoid this dilemma, Prof. Kopp proposes to limit the term isomorphous to those compounds which possess the same crystal-forming power, as proved by their ability to crystallise together, or, if unequal in solubility, the ability of one crystal to grow in a solution of the other. Both of these cases were beautifully illustrated by alums. If a trace of a chromalum solution be added to a solution of potash-alum, each crystal that forms will contain both, as shown by the reddish tinge, and the colour deepens as the quantity of chromalum added is increased. On the other hand, when a crystal of one sort of alum is placed in a solution of the other kind, it continues to grow. Fine specimens of such crystals were exhibited by the speaker, who is remarkably skilful in this matter of growing and nursing crystals. Many other isomorphous salts were exhibited, such as the sulphates of magnesia and nickel; in some cases two different salts had been deposited alternately over the crystal of a third salt. Most interesting were rhombohedra of calxspar covered with nitrate of sodium, thus proving these two bodies isomorphous. The professor acknowledged that he had had much difficulty in obtaining these, and had utterly failed to make a crystal of arragonite grow in a solution of nitrate of potash. Prof. Kopp said, in conclusion, that unlike number of atoms could not replace each other in a molecule of two isomorphous bodies. Sulphate of cadmium will crystallise with eight equivalents of water to three of the anhydrous salt. Sulphate of didymium crystallises with eight equivalents of water. Both have the same crystalline form, but two atoms of didymium seem to replace the three of cadmium:—

$$Di_2S_3O_{12} + 8H_2O;$$
$$Cd_3S_3O_{12} + 8H_2O.$$

But these salts will not crystallise together, and crystals of the latter, from a mixed solution, contain no pinkish tinge of didymium.

HER MAJESTY'S ASTRONOMER AT THE CAPE

MR. DAVID GILL has been gazetted successor to Mr. E. J. Stone in the direction of the Royal Observatory, Cape of Good Hope. The discrimination exercised by the First Lord of the Admiralty in this appointment, we are confident will be appreciated and applauded by astronomers generally. Obtaining his first experience in practical astronomy in the Observatory at Aberdeen, and in a private observatory which he erected in the same place, Mr. Gill was so fortunate as to be associated with Lord Lindsay in the designs and details of the large observatory founded by this nobleman at Dun Echt in 1870, taking the position of chief of the staff. He thus became engaged in the organisation of the expedition to the Mauritius fitted out by Lord Lindsay for the observation of the transit of Venus, on which occasion advantage was taken of the circumstance of a heliometer forming part of the equipment to determine the sun's distance by measures of the planet Juno, being the first trial of the method, and attended with satisfactory results; the details of this work were published by Lord Lindsay as the joint work of himself and Mr. Gill. In connection with the same expedition, Mr. Gill arranged and personally conducted the whole of the chronometric and telegraphic longitude determinations connecting Berlin, Malta, Alexandria, Suez, Aden, Bombay, Seychelles, Reunion, Mauritius, and Rodriguez. It was while engaged upon these operations that he undertook, at the request of the Khedive, the measurement of the first base line of the geodetic survey of Egypt. In 1877 Mr. Gill laid before the Royal Astronomical Society a proposal to determine the sun's distance by heliometric observations of the planet Mars about the very favourable opposition of that year, Lord Lindsay lending his heliometer for the purpose. The proposal met with the support of the Astronomer-Royal and Council of this Society, and was further aided in its execution by a grant from the government funds in the hands of the Royal Society. The Island of Ascension was fixed upon as a favourable station for these observations, and Mr. Gill proceeded to Ascension in June, being occupied there about six months in the necessary preparations and carrying out of the scheme. The reductions are still proceeding, but in proof of the importance attached to this attempt to obtain a reliable value of the solar parallax and the interest felt by the leading astronomers of different nations in his work, it may be mentioned that on asking for aid in the accurate determination of the positions of the stars observed with Mars, his request was cordially acceded to at the following observatories:—Greenwich, Oxford, and Liverpool, Albany, U.S., Berlin, Cambridge, Mass., Cordoba (the national establishment of the Argentine Republic), Königsberg, Leipsic, Leyden, Melbourne, Paris, Pulkova (the Imperial Observatory of Russia), and Washington.

We will express the hope that Mr. Gill may carry to his new sphere a continuance of the great energy he has hitherto shown and repeat our conviction that his nomination by the First Lord to the important position of "Her Majesty's Astronomer at the Cape," will be hailed with great satisfaction in the astronomical world. It is understood that Mr. Gill leaves England early in May, arriving at the Cape in good time to confer with Mr. Stone upon the future work of the Observatory.

OUR ASTRONOMICAL COLUMN

THE NAVAL OBSERVATORY, WASHINGTON.—The Report of Admiral Rodgers, superintendent of this great astronomical establishment, for the year 1878 has just been issued. The operations of the institution have been more than usually extended, involving expeditions for the observation of the transit of Mercury on May 8, and the total solar eclipse of July 29. The 26-inch refractor has been in charge of Prof. Asaph Hall, with Prof. Holden as assistant, and has been constantly employed in the observation of satellites, double stars, and nebulæ, and occasionally of comets. Admiral Rodgers mentions that many foreign astronomers visiting the United States on the occasion of the eclipse, took the opportunity of inspecting this instrument, expressing very generally an opinion that the mounting was too light, and in this opinion the superintendent to a certain degree coincides,

although it is pointed out that during the five years that the equatorial has been mounted, "the position of the pole of the instrument has changed only a fraction of a minute of arc." The observations of the satellites of Saturn refer mostly to Japetus, Hyperion, and Titan. The disappearance of the ring took place February 6; Bessel's elements were verified by observations of its angle of position on thirty-six nights by Prof. Hall, and on twenty nights by Prof. Holden. There are also observations of the satellites of Uranus and Neptune, besides the fine series on the two satellites of Mars which were placed in the hands of astronomers some time since. A good series of measures of the companion of Sirius was obtained, and the six stars in the trapezium of Orion have been measured in connection with observations of Mr. Otto Struve's selected list of stars for determining the personal errors of observers. Prof. Holden observed the Orion nebula on twenty-eight nights, also six others of the more interesting of this class of objects.

The transit-circle and the 9·6-inch equatorial have been in charge of Prof. Eastman; 3,450 observations were made with the former instrument during the year, while the equatorial has been occasionally employed for a very necessary auxiliary purpose when it is desired to observe the fainter or less accurately computed minor planets on the meridian, viz., in determining previously the approximate correction of the ephemerides; for want of this necessary preliminary observed at Washington, a considerable number of observations on the meridian have been put upon record as observations of faint minors, which have been found to belong to small stars, to the equal vexation of observers and computers.

During the transit of Mercury, seventy-two photographs of the planet upon the solar disk were made at Washington by Mr. Rogers, with one of the photoheliographs used for the transit of Venus. Prof. Harkness proceeded to Texas for the observation of this transit of Mercury, succeeding better with the later than the earlier half of the phenomenon. The compilation and discussion of the observations is proceeding under Prof. Eastman, and will soon be ready for publication.

With regard to the total solar eclipse, it is stated that the liberal appropriation authorised by Congress allowed of a number of separate expeditions being organised, and the co-operation of the leading astronomers of the United States was invited and cordially responded to; but, while the Observatory of Washington was enabled to assist in a financial point of view, the heads of expeditions were left free to arrange their own plan of observation. The report enters briefly into particulars of the stations and success of the observers, to which space will not allow further reference here. With respect to the search for an intra-Mercurial planet or planets, it is mentioned that the following, in addition to Prof. Watson, were so occupied, at least during a part of the time that the sun was obscured:—Prof. Asaph Hall at La Junta, Colorado, with a 5-inch Alvan Clark equatorial, power 150 diameters, sweeping south and following the sun to about 10° distance; Mr. O. B. Wheeler at the same place, with a similar instrument, sweeping below and preceding the sun; Prof. Newcomb at Separation, Wyoming, and Professors Holden and Pritchett at West Las Animas, Colorado, also conducted unsuccessful sweeps for an intra-Mercurial planet.

The Washington Observatory has made arrangements for dropping a time-ball in New York city, at noon daily, which took effect from September 10, 1877; there have been a few failures, the cause of which is explained. The volume of observations for 1875 was daily expected to be delivered from the press at the time the Report was drawn up: we presume there are few real astronomical workers who have not experience of the liberality with which the handsome volume annually issued has been distributed by the United States Naval Observatory.

TEMPEL'S COMET, 1867, II.—Since our last note referring to this comet, M. Gautier has published sweeping-ephemerides, in the calculation of which he first assumes the perihelion passage to occur May 10·9416 Berlin mean time (that being the epoch fixed by his calculations after taking into account the action of Jupiter during the present revolution, which has delayed the comet less than three days), and then varies this date by ∓ 4 days; he believes the error of his computation will not exceed these limits. The following are the positions taking T = May 10·9416 for midnight at Berlin, or roughly for 11h. Greenwich time, during the next period of absence of moonlight, or rather beyond it:—

1879.	Right Ascension. h. m. s.	North Polar Distance. ° ′	Log. Distance from Earth.	Intensity of Light.
March 10	15 56 1	98 54·4	0·0960	0·188
,, 14	16 1 41	99 10·5	0·0808	—
,, 18	16 7 2	99 26·2	0·0657	—
,, 22	16 12 2	99 41·6	0·0506	—
,, 26	16 16 39	99 56·9	0·0355	—
,, 30	16 20 51	100 12·6	0·0206	0·278

An acceleration of four days in the time of arrival at perihelion will alter the comet's position on March 10, + 10m. 1s. in R.A., and + 1° 4′ in N.P.D.; and on March 30, + 11m. 51s. in R.A., and + 1° 11′ in N.P.D.

BIOLOGICAL NOTES

NEW FISHES FROM CENTRAL ASIA.—The last number of the *Bulletin* of the Imperial Academy of Sciences of St. Petersburg contains an interesting communication from Prof. Kessler on the fishes obtained by Prjvalsky during his recent expedition to Lob-Nor, a district previously unvisited by any naturalist. Herr Prjvalsky's collection from Lob-Nor and the basin of the Tarim contained examples of eleven species of fishes, eight of which belong to the family of *Cyprinidæ*, and three to that of *Cobitidæ*. As might have been expected, nearly the whole of these are new to science, and belong to genera (*Diptychus*, *Schizothorax*, &c.) characteristic of the high lands of Central Asia. One of the Cyprinoides is so peculiar as to necessitate the institution for it of a new genus, which Herr Kessler proposes to call *Aspiorhynchus*. *Aspiorhynchus prjvalskii*, as Prof. Kessler names this fish, in honour of its discoverer, inhabits the lower Tarim and Lob-Nor, where it attains a considerable size and furnishes an excellent article of food. Prof. Kessler suggests that two of the fishes obtained by the late Dr. Stoliczka during Forsyth's expedition to Yarkand, which were referred by Dr. Day to the genus *Ptychobarbus*, probably belong to his genus *Aspiorhynchus*.

DREDGING OPERATIONS, GULF OF MEXICO.—The last *Bulletin* (No. 9) of the Museum of Comparative Zoology at Harvard College, Cambridge, Mass., contains an account of some wonderful new or rare forms of echini, by A. Agassiz, of corals by L. F. de Pourtalés, and of ophiurans, by T. Lyman, all the specimens having been dredged, during the survey of the United States steamer *Blake*, in the Gulf of Mexico. Preceding the technical descriptions there is a bibliographical notice of the publications relating to the deep sea investigations carried on by the United States Coast Survey from 1850 to the present time. Of the echini described and figured in the present number is a most interesting new species of Dorocidaris (*D. blakei*). While the recent Cidaridæ, so far as at present known, do not by any means show the great variety in the form of their spines, which is found so common among the fossil genera of the family; yet here we have at least one species in which the variety of the shape of the spines is extreme. Its long tapering spines would have indicated its position in Dorocidaris, but its extraordinary flattened fan-shaped spines seem nearly identical with those of the Jurassic genus Rhabdocidaris—when

alive these echini were of a brilliant vermilion colour. *Salenia pattersoni* spec. nov., is described as the most exquisitely coloured of the living Salenidæ, thus far found; the test was of a light cream colour, as well as the shafts of the primary spines. These are banded with a brilliant vermilion, the two colours nearly equally divided. The secondary spines are also cream-coloured, but separated at the base by dark violet lines which extend from the apical to the actinal system. Similar dark violet lines separate the genital and ocular plates. *Conoclypus sigsbei* is described as a magnificent species, by far the most striking sea-urchin which A. Agassiz had ever seen. The first time it was seen the dredge brought up half a dozen of the huge, brilliant lemon-coloured specimens. All these species, as well as the remarkable *Periaster limicola*, are figured from photographs. Count Pourtalés describes a number of new or rare forms of corals. As far as our present knowledge goes, he writes, no sea-bottom can rival in abundance of deep-sea corals the West Indian. It is not at all unfrequent for a single cast of the dredge to bring up a dozen different species represented by more or less numerous specimens of each. A very young specimen of Holopus was dredged from a depth of 100 fathoms. It has been sent for study to Sir Wyville Thomson, but a beautiful figure by A. Agassiz is here given. Several new species of Antedon are described by Pourtalés. A large number of new species and two new genera of ophiuroids are described by Theodore Lyman. The descriptions are accompanied by excellent figures.

United States Fish Commission.—Messrs. G. Brown Goode and Tarleton H. Bean give an account of some fifty species of fishes from the east coast of the United States, some of which are new to science and all of which are new to the fauna of that portion of the American States. Among the more interesting of the new forms may be mentioned *Phycis chesteri*, the largest specimens measured without the tail about eight inches in length; they were taken off Cape Ann. A new species of Dr. Günther's genus Haloporphyrus was taken on the outer edge of Le Have Bank at a depth of 400 to 500 fathoms. Two specimens of the rare *Remoropsis brachyptera* (Lowe) Gill, were obtained; one was found clinging to the side of a sword-fish, harpooned in the channel south-west of George's Bank, and the other on the deck of a Halibut trawler fishing to the north-east of George's Bank, at a time when sword-fish were being taken on the trawls. A specimen of *Nemichthys scolopaceus* was taken alive from the stomach of a cod caught on the same bank. *Amia calva* is reported from St. John's River, Florida, and from Spruce Creek, a tributary of Halifax River, about lat. 28°. Its range has not hitherto been recognised south of Charlestown, South Carolina, from whence Garden sent specimens to Linnæus (*American Journal of Science and Arts*, January, 1879).

American Œdogoniaceæ.—Dr. V. B. Wittrock has just published a revision of the species of Œdogoniaceæ found in America, as far as they are known (*Botaniska Notiser* utgifne af O. Nordstedt, November, 1878). The list contains twenty-three species belonging to the genus Œdogonium, and eight belonging to the genus Bulbochæte. Of these, nine are found in Greenland, five in Pennsylvania, one in California, five in Mexico, three in the West Indies, one in Venezuela, one in Bolivia, and seven in Brazil. It would seem very certain that this number constitutes but a small part of the species which will by further investigations be discovered; still it enables the author to draw, with a considerably high degree of probability, the following conclusions:—1. That the œdogoniaceous vegetation of America differs but little from that of the European. 2. That the species found towards the more northern portion of this area are perfectly identical with those to be met with in Northern Europe, while the species met with in the more southern portion of the same area are either species quite different from those met with in Europe, or, at most, extreme varieties of European forms. Only one of the South American species forms an exception to this (*Œdogonium crispum* (Hass.), Wittr.), which would seem to be nearly a cosmopolitan. 3. That the genus Bulbochæte has in America, as in Europe, most of its species indigenous to the cold temperate or arctic zone. Of the eight species known from America, five are natives of Greenland.

Chemico-Agricultural Stations in Italy.—Stations for the scientific observations of subjects connected with agriculture in its widest sense, have now been for several years established throughout Italy. These are under the general control of a Minister of Agriculture. We have lately received the reports (Atti) of the stations at Rome and Palermo, contributed by Prof. J. G. Briosi; they have, as might be expected, mostly to do with the subject of the diseases of the vine and the olive. Among the more important of these reports are the following: On the Phytoptus of the Vine (*Phytoptus vitis*), with figures; an account of the Marciume of the Vine (*Albinia wockiana*), with figures; on a Fungoid Disease attacking Lemons (*Fusisporium limoni*), with figures. At Messina a lemon-tree, in good condition, of fair size, will, it is reckoned, produce about 2,000 ripe fruit each year. These fruits are sold at from twenty to forty lire the thousand, according to size and quality, so that a lemon orchard is of great value, and a good deal of distress has been caused by the destruction of the lemon crops by this disease.

Asparagin in Plants.—The physiological *rôle* and distribution of asparagin in the plant kingdom have been lately studied by Herr Borodin (*Botanische Zeitung*, 51 and 52, 1878). He states, as the result of his researches, that whenever a vigorous part of a plant becomes poor in non-nitrogenous substances, asparagin occurs as a product of decomposition, and accumulates. This may be explained in either of two ways: either the presence of non-nitrogenous matters hinders the decomposition of albumen, while these alone are decomposed; or (conversely) in life albumen is always decomposed and asparagin constantly formed, but where carbohydrates are present albumen is regenerated, and it is only where these are deficient that asparagin accumulates. The former hypothesis supposes different processes of decomposition in life according as carbohydrates are present or not; Herr Borodin thinks it therefore the more improbable, and adopts the other, doing so the more readily that the regeneration of albumen from asparagin and carbohydrates certainly occurs, and is necessary for the transference of the albuminous matters. Not all carbohydrates are adapted for regeneration of albumen from asparagin, and therefore asparagin may accumulate even when carbohydrates are present. Such unsuitable carbohydrates are starch and the oils, whereas glucose is the suitable form.

THE PIC DU MIDI OBSERVATORY

OUR readers may remember that early in the year General de Nansouty, the hardy director of the Pic du Midi Meteorological Observatory, was cut off from communication with the world below, the severe weather having so affected the telegraph as to prevent it from acting. Fears were entertained for the General's safety, and M. Albert Tissandier resolved to organise a party for the ascent of the Pic and the succour of the veteran observer. An interesting account of this ascent appears in *La Nature*, to which we are indebted for the accompanying illustrations. The snow-storm having somewhat abated at Bagnères-de-Bigorre on January 9, M. Tissandier resolved to attempt the Pic next day, in company with three of General Nansouty's usual guides.

They set out at 9 A M. on the 10th, and in spite of the deep snow and fallen avalanches, the ascent was at first not difficult. After equipping themselves for snow work at some huts occupied only in summer, the ascent was begun in earnest. The weather was grey and uncertain, the temperature 0° Cent., with a thick mist that prevented anything being seen beyond 300 metres. The snow became deeper and deeper as they advanced, and one of the guides went before to show the way, the others following the marks of his footsteps up the steep slope of the mountain side. Sometimes they were buried to the waist, and often they had to rest to recover breath. The ascent was slow and difficult, but they were often rewarded by the magnificent effects resulting from the play of light upon the snowy landscape beneath, or of the clouds advancing majestically into the midst of the snows. After attaining an altitude of 6,000 feet, they had got over the steepest part of the slope. But now the weather changed, the wind rose, and mists more and more obscured the sky. Squalls of snow were driven into their faces, and seriously hindered their progress. Alongside the track heaps of snow showed where avalanches had recently fallen from the rocks above. The telegraph posts, 7 metres high, were often buried; five or six of them were even broken by the violence of the recent storms, and the wires were broken. The weather got worse as they ascended, and M. Tissandier had all the symptoms of mountain-sickness, which he had not experienced before, even when ascending Mont Blanc. At last, however, the summit was reached, and, as might be expected, General de Nansouty gave the party a warm reception. A glorious fire and an excellent dinner soon set M. Tissandier all right again.

The establishment of the General is far from being luxurious, M. Tissandier tells us; although none of the usual necessaries of life are wanting, one is struck with the devotion which impels him, for the sole purpose of advancing science to accept an existence so isolated, so primitive, and that during eight months of the year.

The observatory of the Pic du Midi is most picturesque. We enter first a passage with glass doors at the sides, in order to protect as much as possible from the violence of the wind and the gusts of snow. The telegraphic office is at the bottom. A respectable provision of wood furnishes this passage; a few hens inhabit it; one of them was slaughtered in M. Tissandier's honour. A room adorned with an immense fireplace is next presented to the visitor's view; it is the vestibule. The guides sleep here on a camp bed, and have for messmates two dogs and two cats, presided over by the intendant, the faithful guardian of the observatory. All round this apartment, carefully arranged as on shipboard, may be seen a variety of provisions. The dining-room opens in this vestibule. In summer a separate part of the building is arranged for the reception of tourists, and a stable for horses is placed below the principal structure.

To the first storey there is no staircase, as there is no room for it; there is only a ladder with a knotted cord as balustrade. On ascending this, a small vaulted room is entered; a stove ruddy with fire heats the whole floor, and the cold of the outside is unknown in these hospitable chambers. The chief ornaments of this apartment consist of two sets of beds, one near the floor, used by M. Bazlac, the second observer and devoted companion of General de Nansouty. Above is another bed, or rather shelf, to use the General's expression; this is for the use of visitors. It is reached by a ladder, and the mattress consists of an excellent sheepskin, on which, M. Tissandier declares, he slept so soundly, 8,000 feet above the sea, that he reluctantly left it on the morning after his arrival. On this first floor the General has a workroom in common with M. Baylac. This room is too small for the work which has to be done in it.

Everybody is up at daybreak; this is the inexorable order. The General then begins the day's observations. It is necessary to go outside to examine the thermometers and barometers, which are placed under a shelter constructed on a stone terrace. Every two hours, and oftener when the atmospheric conditions require it, the observations are renewed, precisely recorded, and preserved with care. Thus the whole day is passed, night alone putting an end to the work. M. Tissandier bears testimony to the energy and patience of the courageous observer of the Pic du Midi in carrying on his work.

Fig. 1.—Ascent of the Pic du Midi, January 10, 1879.

Happily the rather too primitive arrangement of the General will soon be changed for the better, thanks to the generous donations of those who love and desire to advance science.

During the small amount of leisure which can be found between the hours of observation, General de Nansouty directs his companion in a great variety of labours. A very interesting herbarium of the flora of the high regions of the Pic du Midi has thus been formed. M. Tissandier admired some rare plants, such as *Gentiana glacialis*, *Daphne cneorum*, *Salix herbacea*, &c. Mineralogical

FIG. 2.—Observatory of the Pic du Midi.

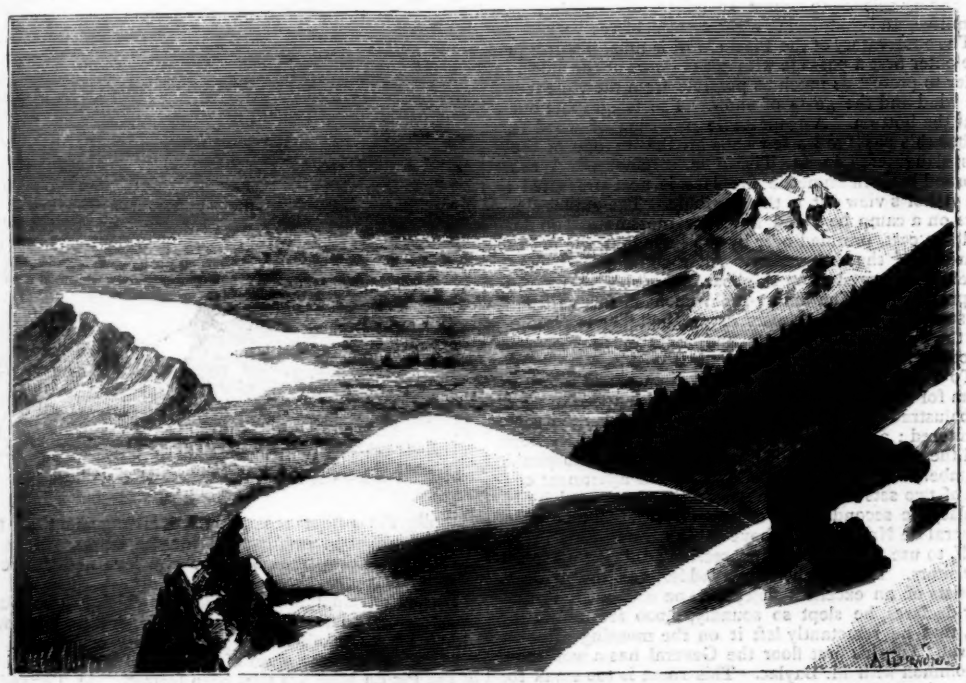

FIG 3.—The crests of Penne Longue (Pic du Midi) emerging above the clouds.

specimens are also collected and arranged. Traps are also laid by M. Baylac, and thus a fine collection of ermine skins has been formed.

The guides repaired the damage to the telegraph which had interrupted the General's communication for ten days. M. Tissandier says rightly that these accidents

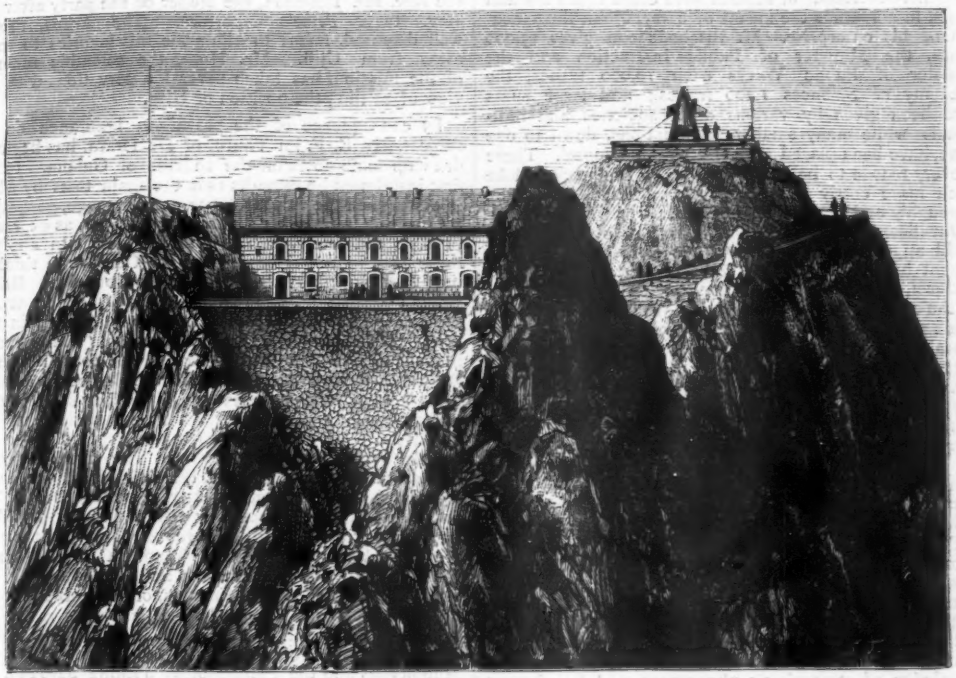

FIG. 4.—View of the New Observatory of the Pic du Midi, now building.

should not be allowed to happen to a man who so generously devotes himself to the progress of a department of science that is of the greatest national utility. For at least a part of the distance between the summit and the plain the wires should be placed underground, and thus beyond the reach of injury from avalanches and

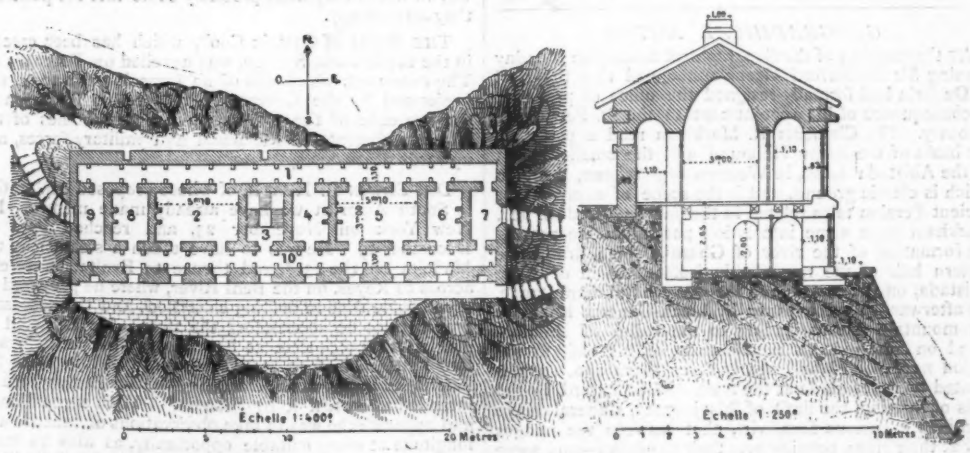

FIG 5.—Plan and section of the New Observatory. Plan of the first floor:—1, Passage, magazine; 2, *Salon*; 3, Staircase; 4, Dining-room; 5, Work room; 6, Guest-chamber; 7, Telegraph; 8 and 9, Bed-rooms. The ground-floor will be used for provisions.

storms. After M. Tissandier's visit, our readers may remember, telegraphic communication was again interrupted with the Pic. M. Tissandier bade the General good-bye on the 12th, and during his descent took several sketches. While it took him nine hours to make his ascent, he came down in four.

The improvements contemplated by General de Nansouty comprise an entirely new and much more solid and durable structure at the very summit of the mountain. A few generous friends of science have come to his aid and placed in his hands the means of carrying out the execution of his enterprise. M. Bischoffsheim gives 15,000 francs, the Minister of Public Instruction and the Minister of Public Works each 10,000 francs, the Academy of Sciences 1,200 francs; and large sums have been given by various other societies and individuals while many smaller subscriptions, down to one franc, have been placed at the General's disposal. There is every reason to believe, that though the work will be much more costly than originally expected, it will be thoroughly and promptly completed.

Our illustration (Fig. 4) shows the new observatory as it will appear when the works are completed; it is at present half built. To the right is seen, perched on a platform, the shelter for the instruments of observation. In the centre is the dwelling-house, the arrangements of which will be seen in the plan, Fig. 5. To the left is the lightning-rod, intended to protect the structure from the lightning which so frequently strikes the summit of the Pic. This lightning-rod, with its cable, which plunges 500 metres lower down in Lak Oncet, has cost 2,800 francs. The excavation of the hollow in which the structure is built has cost 2,500 francs; so much of the building as has been raised, that is one half, has cost 22,000 francs. No doubt all the necessary funds will be forthcoming; it is said that the Minister of Public Instruction will this year contribute another sum of 10,000 francs.

The example of General de Nansouty has already borne fruit in France. General Farre has installed an observatory at the foot of Infernet. In Provence a movement has been set on foot to place one on Mont Ventoux. With the fine observatory of the Puy de Dôme, France will possess an important net-work of high meteorological stations which cannot but render valuable services to a knowledge of atmospheric phenomena, and be of great practical value to national industry. Let us hope that in a very few months our own country will possess at least one of these lofty stations which the French Government, the French people, and French science think it their interest and duty to give substantial encouragement to.

GEOGRAPHICAL NOTES

AT the meeting of the Geographical Society on Monday evening Sir Rutherford Alcock announced that the Earl of Dufferin had formally resigned the office of president in consequence of his appointment to the St. Petersburg embassy. Mr. Clements R. Markham read a paper on the basin of the River Helmund and the smaller basin of the Abistada Lake, in Western Afghanistan, a region which is classic ground, and is the scene of many of the ancient Persian tales related in the pages of Ferdosi. Mr. Markham gave some interesting particulars respecting the formation of the river of Ghazni, which drains the eastern half of the remarkable isolated basin of Lake Abistada, on the east side of the western Sulimani Range. He afterwards read a paper by Lieut.-General Kaye, on the mountain passes leading to the valley of Bamian, based on that officer's recollections of his visit to the region north of Kabul, nearly forty years ago, supplemented by notes made at the time. With regard to the idols of Bamian, the limit of his journey, General Kaye mentions a curious fact, viz., that between the images and at their sides, peeping over their shoulders—and some even above their heads—were many caves in the cliff-side on which they are cut, having intricate connecting approaches and galleries cut within the rock; these formed dwellings for many Bamianchis and also for some camp-followers of the British. The two papers were illustrated by the large diagram of Afghanistan which has just been constructed for the Society.

THE London Missionary Society have received letters down to October 17 from their mission at Ujiji, on Lake Tanganyika, which announce the death from apoplexy of the Rev. Mr. Thomson, the leader of the party after the Rev. Roger Price's departure. The Arabs, though well disposed, refuse to allow the missionaries to settle away from Ujiji. Mr. Hore, the scientific member of the mission, has taken several observations with the view of settling the position of Ujiji.

IN consequence of the prevailing ignorance on the subject, Mr. E. F. im Thurn, of Demerara, has begun to draw up some notes on the Indians of Guiana. In the first instalment he remarks that the main tests by which to distinguish the various tribes are language, geographical position, physical features, and customs, as expressed in their characters, habits, and legends. In applying these tests to the tribes of British Guiana he thinks it best to look first at their geographical position. British Guiana consists of three regions—the coast region nearest the sea, within that the forest region, and within that again the savannah region, which passes without break into the great savannahs of Brazil. The coast region, in the north, towards the sources of the Orinocco, is inhabited by the Warau Indians, and further south by the Arawacks, while here and there are settlements and families of the Caribisi, a term which appears to be not strictly synonymous with Caribs. The forest region is almost entirely inhabited by the Ackawois, with a very few Carabisi settlements scattered among them. The Savannah region is peopled by a large number of tribes. Beginning from the north towards the Orinocco, the chief are the Arecunas, Macusis, Wapianas, and Atorais. Further south are the Tarumas and Woiowais, and the small remnants of the Maopityans, or Frog Indians, and the Pianoghottos. Here and there travellers report the existence of other tribes, but these Mr. im Thurn maintains to be groups of hybrids between two tribes. Of the Maopityans and the Pianoghottos nothing beyond a few details as to their peculiar personal appearance and manners is known, and of the Woiowais only the name is known. Mr. im Thurn next dwells at some length on the linguistic peculiarities of the other tribes mentioned, excepting the Tarumas, and he afterwards describes the way in which they most probably came into the positions they now occupy.

THE statue of Captain Cook, which has been erected in the Hyde Park, Sydney, was unveiled on February 25. The ceremony, which was of an imposing character, was performed by the Governor, Sir Hercules Robinson, in the presence of the Ministry, the public bodies of the city, detachments of the naval and military forces, and upwards of 20,000 spectators.

DR. EDWIN R. HEATH, of whose proposed exploration in South America we have already made mention, left New York on November 23, and reached Pará on December 19. He was to have taken a steamer up the Madeira on the 23rd, and thence to Exaltacion or else across to Reyes, on the Beni River, where he proposed to spend some time in making collections and the necessary preparations for descending the river. He expected to obtain Greenwich time at San Antonio, the latitude and longitude of which is well established, and to work his longitudes by them until arriving at the Beni, where he intended to correct it by "lunars." With a good outfit and apparatus he was to take observations of latitude and longitude at every suitable opportunity, as also to make records of the thermometer, barometer, and boiling-points. After completing all his preparations at Reyes, and having his *balsa* properly constructed and equipped, he proposed to commit himself to the current, and take his chances of what might happen.

THE Minister of Public Instruction at Paris has received an interesting communication from Dr. Jules

Crevaux (see NATURE, vol. xix. p. 298), written on October 30 from the River Kou, an affluent of the Yary, one of the lower tributaries of the Amazon. When he last wrote he had just crossed the crest of the Tumuc-Humac range. The Rouassir, an affluent of the Kou, was at length reached, after many difficulties, on September 27, but proved to be navigable for less than 250 yards; its course then led through a marshy country, in which it was divided into numerous streams, encumbered with a virgin vegetation, which had to be cut through. The party only reached the confluence of the Kou on December 2. Here Dr. Crevaux met some members of the Roucouyenne tribe whom he had seen before, and who were journeying towards the Oyapock River, in Guiana. They took his letters and some of his collections, while a few of them undertook to remain with him and guide him to the Yary, and thence to the Paru.

AT a recent meeting of the Geographical Society of Lyons, Capt. Baudot read a report on M. Duponchel's project of a railway from Algeria to the Senegal. He characterised the scheme as a dream and an illusion, and basing his remarks on his experiences gained during a long sojourn in Algeria, he enumerated the difficulties which rendered the project incapable of realisation in our time.

WE have received the first part of a new edition of Stieler's well-known Hand-Atlas, published by Perthes, of Gotha. A large number of new maps are promised; one of these, North-West Africa, is contained in the first part, and seems to us to be well up to date. It is only four years since the last edition was published, but much has happened during the interval to render a new one necessary.

A NEW Society of Geography has been established at Nancy, the head town of French Lorraine, and the first meeting took place on February 24. Another Society of Geography for Normandy has also been found at Rouen.

AT a recent meeting of the Berlin African Society, the sum of 2,000 reichsmark was awarded to the well-known traveller, Herr Ad. Krause, who is now in Northern Africa, for a special tour to the Ahaggar mountain range. A further sum of 20,000 mark will be distributed amongst several other travellers shortly. In the next part of the Society's *Mittheilungen*, interesting reports just come to hand from Drs. Gerhard Rohlfs and Buchner, will be published.

IT is stated that Major Butler, of the 9th Regiment, has returned to India from Turkestan, after completing a survey of nearly 6,000 miles of the country. In the course of his explorations he visited and held a conference with the Tekké Turcoman chiefs at Kizil Arvad, which was afterwards occupied by the Russians, but from which it is said that General Lomakin has found it necessary to beat a retreat.

IN the list of observations for fixing positions on the Amazons, taken by Commander Selfridge, U.S.N., which were recently published in the *New York Herald*, we learn that by an accidental error the longitude of Pará was given as 48° 59′ 15″, instead of 48° 29′ 15″, and that the latter will have to undergo a correction of 50″ for the difference between the meridians of the Rio de Janeiro Observatory and Fort Villegagnon, the distance having been erroneously calculated from the latter.

UNDER the title of "L'Amérique Equinoxiale" M. Ed. André has just commenced, in the *Tour du Monde*, a series of admirably illustrated papers on the United States of Colombia, Ecuador, and Peru, in which he travelled on a scientific mission from the French Government in 1875-6.

NOTES

FREDERICK SMITH, F.L.S., assistant-keeper of the zoological department of the British Museum, died on the 16th inst. at the age of seventy-three. Mr. Smith had devoted himself to entomology, and was one of the first living authorities on hymenopterous insects.

THE first *soirée* given at the Paris Observatory by Admiral Mouchez took place on February 21, and was very successful. More than a thousand persons belonging to influential circles visited the scientific exhibition of telephones, microphones, electric pens, Feil's new specimens of artificial gems, &c. A lecture was given by M. Wolf illustrating a new projection by electric light; the revolution of a radiometer could be observed for the first time on a screen. Admiral Mouchez had secured the services of the band of the Republican Guard, and a ball terminated the proceedings. Science seems to be somewhat more human and gay in Paris than in London; we do not think this does any harm to science, and is certainly a very effectual method of spreading an interest in it.

ENCOURAGING experiments were made at the British Museum on Tuesday night in lighting up the reading-room by means of the electric light. To-night further and more complete experiments are to be made, and we trust that as the result a considerable extension of working-hours will be possible for the hundreds who make the great room their daily workshop. A week or two ago the enterprising authorities of the Dundee public library made similar experiments with hopeful results. For such purposes there can be no question of the utility of the light, if suitable and safe arrangements could be made. The form of light used at the Museum was the modification of the Jablochkoff candle introduced by the Société Générale d'Électricité. By way of experiment the electric light has recently been introduced into the Vienna Art Exhibition at the "Künstlerhaus" and has enabled the directors to keep open their picture galleries until late at night. The experiment was a perfect success, and the new light will remain permanently established at the galleries.

THE subjects of the Croonian Lectures for this year are announced. Lecture I. will be on the physical basis of auscultation, Lecture II. on tension, Lecture III. on the rate of the heart's hypertrophy. All the lectures will be illustrated by means of physical experiments and oxyhydrogen projection. The lecturer is Dr. W. H. Stone.

ON Wednesday, March 5, Prof. Flower will give the first of his nine lectures at the College of Surgeons, on the comparative anatomy of man, in continuation of the course of last year, to be continued on Mondays, Wednesdays, and Fridays, at 4 o'clock, to March 24. The following are the heads of Prof. Flower's lectures:—Recapitulation of the best ascertained facts in connection with the subjects treated of in the last course, including the physical characters and geographical distribution of the Australian, Tasmanian, Melanesian, Papuan, Malay, and Polynesian races, with further illustrations from recent additions to the Museum; the inhabitants of the Andaman Islands, briefly touched upon last year, will next be treated of in detail, as typical examples of the Negrito race, and their osteological characters and relations to other races demonstrated from a series of skeletons and crania lately received; the Mongolian type and its various modifications, illustrated as far as the materials in the Museum permit; ethnology of Eastern and Southern Asia; the Ainos, a non-Mongolian people of Northern Japan; the Eskimos. The lectures are free to all who are interested in the subject.

A NEW society has been created at Paris for aëronautics. It is styled "Académie d'Ascensions météorologiques," and a

museum is being fitted up and will be opened in March for public inspection, admittance free. It contains all the apparatus devised for constructing or directing balloons or taking meteorological observations in the air.

WE regret to see from the *Times* correspondent at Daka, that notwithstanding all that science has done for warfare, the Afghan war has been an unscientific one. "India," he states, "is unprepared for scientific war." "The enemy like ourselves possesses arms of precision and artillery. Their artillery at Ali Musjid and the Peiwar Kotal was probably equal if not superior to our own. Rockets, however, so easily carried over rough mountain roads, and so terrifying to barbarians from their eccentric course, exciting their astonishment more than any other appliances of art except the telegraph, have never been introduced in the campaign. Nor have any steam launches been sent to traverse the navigable Cabul river, explore its windings, and secure the left flank from gatherings of the enemy. No lime-lights or other lights, of which science boasts so many, have ever been supplied to prevent the enemy perpetually harassing our troops and disturbing their much-needed repose by creeping within range under cover of night and firing into our camp." This is rather disheartening, and we trust that in the campaign against the Zulus more attention will be paid to recent applications of science, and that for example night surprises will be made impossible by the use of one or other form of light which by a little ingenuity might be made to light up all the ground around any position.

AN unusually brilliant meteor was seen in the north of England on Monday morning at about twelve minutes to three o'clock. It is described as a pear-shaped ball of fire in the northern heavens, which travelled slowly downwards towards the horizon, and emitting scintillations and a light of great brilliancy almost equal to that of day, so great indeed that it is said the smallest print could have been read. The light having disappeared, a sound, described by some as resembling the discharge of heavy cannon, and by others as that of the rumbling of distant thunder, was heard, but in all cases it seems to have been sufficiently violent to rattle windows, &c., and to have raised various speculations as to what could be the cause, some ascribing it to an earthquake, others to lightning, while others who saw the meteor set it to the account of that unearthly visitor.

A SMART shock of earthquake, lasting about four seconds, was felt at North Unst Lighthouse, Shetland, on January 4, at five minutes past one o'clock in the afternoon. At 7.45 A.M. on Sunday week, a smart shock was felt at Milan and Brescia.

A SIMPLE and convenient way of demonstrating the vibratory movements of chords, is described by M. Schwedoff in a recent number of the *Journal de Physique*. The stationary waves of the chord are produced by means of an electric trembler (like that used for bells), the chord being attached at one end to the soft iron palette, and caused to vibrate transversely. The other end of the chord is attached to a stretcher for varying the tension. A movable runner allows of varying the length of the vibrating portion. A blackened board with figures on it is supported behind the chord.

BY last accounts from China we learn that Mr. C. Moreno, the agent of the American projectors of a scheme for connecting China with the west coast of America by a submarine cable, is now at Tientsin for the purpose of soliciting the support of the Chinese Government. The Japanese are said to have promised assistance if the project finds favour at Peking.

AN interesting archæological observation has recently been been made quite accidentally. It is well known that the urns found on Roman burial-grounds and containing the bone remains of cremated bodies are often covered with clay cups or dishes. The object of these dishes was supposed to have been to contain spices, which sent forth agreeable odours during the progress of the cremation. Herr Dahlem, a well known German archæologist, was able to verify this view in the following manner. He had obtained a dish of this kind which was broken, and after cementing it had placed it upon a stove for the purpose of drying the cement. Shortly afterwards he noticed a strong and by no means unpleasant odour proceeding from the heated dish. It seems therefore that the ingredients burnt in the dish some fifteen centuries ago had left traces behind, which announced their presence upon becoming heated. Herr Dahlem remarks that the odour was not unlike that of storax.

PROF. C. V. RILEY, entomologist of the U.S. Department of Agriculture, reports that serious complaints have come from the Pacific slope during the year of a new insect that is killing many of the orchard and ornamental trees in that section of the country. Specimens received from Mr. A. W. Saxe, of Santa Clara, California, show it to be a species of *Dorthesia*, an abnormal bark-louse (family *Coccidæ*). It is an Australian insect (apparently *D. characias*, Westw.), and has of late years been introduced on Australian plants into South Africa, where, according to Mr. Roland Trimen, curator of the South African Museum, it has multiplied at a terrible rate, and become such a scourge as to attract the attention of the Government. It has evidently been introduced (probably on the blue gum or eucalyptus) to California, either direct from Australia or from South Africa, and will doubtless become a great evil, because most introduced insects are brought over without the natural enemies which keep them in check in their native country, and consequently multiply at a prodigious rate. The best remedy is a judicious use of kerosene or linseed-oil.

IN the *Revue d'Anthropologie* for January, 1879, Dr. Gustave Le Bon contributes an important memoir, "Recherches anatomiques et mathématiques sur les Lois des Variations du Volume du Cerveau et sur leurs Relations avec l'Intelligence." One of the most interesting of his conclusions is that relating to the cranial differences between the sexes, both in weight of brain and dimension of skull. This question has long been studied by English anthropologists, and recently conclusions have notably been drawn by Mr. Darwin in his chapter on "Difference in the Mental Powers of the Two Sexes," in his "Descent of Man," and collaterally by Mr. Fras. Galton, in his work on "Hereditary Genius." Dr. Le Bon states as the result of his investigations that the female brain is not only less in weight than that of man, but that this inferiority exists "à âge égal, à poids égal et à taille égale," and that the cranial differences between the sexes are greater among the cultivated and more highly-developed races than among those in the most primitive condition, which he ascribes to the fact that the mental activity of civilised society is conducted in the aggregate by the male sex. These conclusions are highly corroborative of the views advanced in a paper read before the Anthropological Institute of London in 1874 (Distant, "On the Mental Differences between the Sexes," *Journal* of the Anthropological Institute, vol. iv. p. 78). Dr. Le Bon points out also the important fact that though the average capacity of the crania of the superior races is much greater than that of the less-developed ones, still what really constitutes the superiority of one race over the other is that the civilised races contain necessarily more largely-developed crania than can be found among the inferiorly developed races. As regards a strong opinion often held as to the superiority in size of the left hemisphere of the brain over that of the right, Dr. Le Bon can add nothing in confirmation. From a measurement of 287 crania he found inequalities indicated on either side in such proportion as to preclude his describing them as anything but a variable character: "sans qu'il soit possible d'assigner des raisons sérieuses à cette inégalité de développement."

ONE of the most interesting questions in American archæology has long been that of the age of the "mound-builders." Modern views seem now opposed to a prehistoric date for these people. Amongst other American workers who have inclined to the more recent date of these structures may be mentioned S. F. Haven, who considered the ancestors of the present Indians to have been the authors of these erections, and Dr. P. J. Farnsworth, who believed that the mound-builders were identical in race with the historical Indians of North America. On this subject a paper read before the Congrès International des Américanistes, 1877, by M. F. Force, has just been reprinted in pamphlet form by Clarke and Co., Cincinnati, 1879, entitled "To what Race did the Mound-builders belong?" The following are some of the author's conclusions:—That so far as indications are given by the growth of vegetation, it is not necessary to hold that any of the works were abandoned more than one thousand years ago. That the absence of all tradition concerning the mounds among the recent Indians is no proof of their great antiquity, as Indian tradition is short-lived and evanescent. Although the advent of De Soto with his armed followers, pillaging and ravaging the country, must have been calculated to make a deep impression, yet, when Europeans visited the country a century and a half later, they found not a vestige of a tradition of De Soto. Finally, Mr. Force considers that the mound-builders were tribes of Indians, more advanced than [the Algonquins or the Dakotahs, but much less advanced than the Aztecs or the Peruvians, and on the same plane with the Pueblo Indians, and that they were living in full prosperity in the time of Charlemagne. Mr. Force reviews the evidence as to their antiquity derived from an examination of crania from these mounds, and endeavours to prove that either the skulls were not obtained from the mounds under consideration, or in other instances would not bear the conclusions based on their examination.

A CURIOUS thermo-magnetic motor, devoid, probably, of practical value, but having some scientific interest, has been devised by Prof. Houston and Thomson (*Journal* of the Franklin Institute). A disk or ring of thin steel is mounted on a vertical axis so as to be quite free to move with its edges opposite the poles of a horse-shoe magnet. The wheel of course becomes magnetised by induction. On heating a section of it, it begins to move. The reason is, that the heated section has its coercitive force increased, and so, being less powerfully magnetised by the induction of the adjacent pole, than the part next it, the attraction exerted by the pole on this latter part is sufficient to cause motion. A constant source of heat gives continuous rotation. The disk must be sufficiently thin to prevent its acquiring a uniform temperature. The heat may be applied at diametrically opposite parts, with similar effect. What renders the motor of little value is the amount of heat required, being so enormous as compared with the force developed.

THE *Monats-Berichte der Berliner Akademie* (September and October 1878) contain some researches by M. Paalzow on the spectrum of oxygen: as, however, M. Paalzow has fallen into the old and common mistake of taking the spectrum of carbonic oxide for the spectrum of oxygen, he cannot be said to have made any decisive addition to our knowledge.

A CEYLON paper furnishes some interesting notes respecting the culture of the cinchona tree in the island. The variety known as *C. succirubra* yields a large quantity of bark, and is so hardy that, though the proper zone of elevation for its culture is from 2,000 to 4,500 feet, many planters are induced to try it at higher elevations. The zone for *C. officinalis* is from 4,000 feet upwards, and it has been grown on Dodabetta at a height of 8,000 feet, but in that case the bark of the unmossed tree becomes covered with lichens. *C. calisaya* will grow wherever the last-named variety does. *Cinchona officinalis* is highly recommended as a sheltering tree for coffee-shrubs against the effects of wind.

THE first number of the *Journal* of the Russian Physical and Chemical Society (both societies now united) contains an interesting paper by M. Beketoff on the specific heat of hydrogen when compounded with palladium; a paper by M. Ponomareff on derivatives from uric acid; additions and corrections, by Prof. Menschutkin, to his papers on etherisation of secondary alcohols; two papers on organic chemistry by MM. Kiabinine, Saytzeff, and Semlianitzin; and a paper by M. Lermantoff on the chemical and photographic action of light. Many very interesting notes give a very complete account of recent work in chemistry.

THE formation of hail and the various causes which contribute to it are still a very obscure question in meteorology. The following points on which information is desired have lately been indicated by M. Colladon:—1. Dates as exact as possible, and made comparable with the hour at Paris, Berne, or Geneva, of the commencement and end of the hail shower; extent of the surface covered. 2. Average and maximum dimensions of hailstones, their form, the average or maximum number of layers they present. Do the successive layers increase in thickness from the central nucleus? 3. Apparent form and elevation of hail clouds; have they the appearance of a vast continuous gyratory movement, or simply of movements of attraction and repulsion? Multiplicity of flashes, their average number per minute; are they, or not, accompanied by resounding noises and frequent descents of lightning on the ground? or are they mostly mute? Are there notable falls of hail without apparent and well-marked electrical phenomena? 4. Average temperature of the air before or during an electric storm, and temperature of the rain-water accompanying it, at the moment of its fall. M. Colladon has contrived an inexpensive apparatus for measuring the last item (*La Nature*, February 15). A funnel conducts the rain to a capsule holding the bulb of a minimum thermometer which has the upper part of its stem bent horizontally and a scale attached to this part.

IN a note on brewing contained in a report on Sapporo and Ishcari (Japan) we read that the beer is poor, weak stuff that will not keep. In course of time, however, it is fully expected that the art of brewing will succeed, more especially as a native director has spent several years in America and Europe devoting his attention to brewing. The hops used, it seems, are imported, and foreign hop seed has been sown, the plants raised from which appear to be doing well. The wild hops, which are found in great abundance on the road from Morarau to Sapporo, and have been found to be unsuitable for brewing in their wild state, are now being cultivated, as it is supposed that by care and attention they will prove to be as good if not better than foreign hops. Consequently great pains are now being taken with these hop plantations.

THE additions to the Zoological Society's Gardens during the past week include a Green Monkey (*Cercopithecus callitrichus*) from West Africa, presented by Mr. Douglas Murray; a Bennett's Wallaby (*Halmaturus bennettii*) from Tasmania, presented by Mr. W. E. Windus; a Common Hare (*Lepus europæus*), British Isles, presented by Mr. Alfred Withers; two Indian Barred Doves (*Geopelia striata*), a Chinese Turtledove (*Turtur chinensis*) from India, presented by Capt. H. Braddick; a Tayra (*Galictis barbara*) from Panama, two Grand Galagos (*Galago crassicaudatus*) from East Africa, three Australian Wild Ducks (*Anas superciliosa*) from Australia, two Cardinal Grosbeaks (*Cardinalis virginianus*) from North America, purchased; a Spotted Eagle Owl (*Bubo maculosus*) from Africa, deposited; two Prairie Marmots (*Cynomys ludovicianus*) from North America, received in exchange.

ON A NEW CHEMICAL INDUSTRY ESTABLISHED BY M. CAMILLE VINCENT[1]

"AFTER I had made the discovery of the *marine acid air*, which the vapour of spirit of salt may properly enough be called, it occurred to me that, by a process similar to that by which this *acid* air is expelled from the spirit of salt, an *alkaline* air might be expelled from substances containing the volatile alkali. Accordingly I procured some volatile spirit of sal-ammoniac, and having put it into a thin phial and heated it with the flame of a candle, I presently found that a great quantity of vapour was discharged from it, and being received in a basin of quicksilver, it continued in the form of a transparent and permanent air, not at all condensed by cold."

These words, written by Joseph Priestley rather more than 100 years ago, describes the experiment by which ammonia was first obtained in the gaseous state. Unacquainted with the composition of this alkaline air, Priestley showed that it increased in volume when the electric sparks are passed through it, or when the alkaline air (ammonia) is heated, the residue consists of inflammable air (hydrogen). Berthollet, in 1788, proved that this increase in bulb is due to the decomposition of ammonia into nitrogen and hydrogen, whilst Henry and Davy ascertained that two volumes of ammonia are resolved into one volume of nitrogen and three volumes of hydrogen.

The early history of sal-ammoniac and of ammonia is very obscure. The salt appears to have been brought into Europe from Asia in the seventh century, derived, possibly, from volcanic sources. An artificial mode of producing the ammoniacal salts from decomposing animal matter was soon discovered, and the early alchemists were well acquainted with the carbonate under the name of *spiritus salis urinæ*. In later times sal-ammoniac was obtained from Egypt, where it was prepared by collecting the sublimate obtained by burning camel's dung.

Although we are constantly surrounded by an atmosphere of nitrogen, chemists have not yet succeeded in inducing this inert element to combine readily; so that we are still dependent for our supply of combined nitrogen, whether as nitric acid or ammonia, upon the decomposition of the nitrogenous constituents of the bodies of plants and animals. This may be effected either by natural decay giving rise to the ammonia, which is always contained in the atmosphere, or by the dry distillation of the same bodies, that is by heating them strongly out of contact with air, and it is from this source that the world derives the whole of its commercial ammonia and sal-ammoniac.

Coal—the remains of an ancient vegetable world—contains about 2 per cent. of nitrogen, the greater part of which is obtained in the form of ammonia when the coal undergoes the process of dry distillation. In round numbers 6,000,000 tons of coal are annually distilled for the manufacture of coal-gas in this country, and the ammoniacal water of the gas-works contains the salts of ammonia in solution.

According to the most reliable data 100 tons of coal when distilled so as to yield 10,000 cubic feet of gas of specific gravity 0·6, give the following products, in tons:—

Gas.	Tar.	Ammonia Water.	Coke.	
22·25	8·5	9·5	59·75	Average.

This ammonia-water contains about 1·5 per cent. of ammonia; hence the total quantity of the volatile alkali obtainable from the gas-works in England amounts to some 9,000 tons per annum.

A singular difference is observed between the dry distillation of altered woody fibre as we have it in coal—and woody fibre itself. In the products of the first operation we chiefly find in the tar the aromatic hydrocarbons such as benzene, whilst in the second we find acetic acid and methyl-alcohol are predominant.

The year 1848 is a memorable one in the annals of revolutionary chemistry, for in that year Wurtz proved that ammonia is in reality only one member of a very large family. By acting with caustic potash on the nitriles of the alcohol radicals, he obtained the first series of the large class of compound ammonias, the primary monamines. Of these, methylamine is the first on our list:—

$$\left.\begin{matrix}CH_3\\CO\end{matrix}\right\}N + 2KOH = \left.\begin{matrix}CH_3\\H_2\end{matrix}\right\}N + CO\left\{\begin{matrix}OK\\OK\end{matrix}\right.$$

The years that followed, 1849-51, were prolific in ammoniacal discovery. Hofmann pointed out that not only one atom of hydrogen in ammonia can be replaced by its equivalent of organic radical, but that either two or all of the three atoms of the hydrogen in ammonia can be likewise replaced, giving rise to the secondary and tertiary amines by the following simple reactions:—

$$1.\quad CH_3I + \left.\begin{matrix}H\\H\\H\end{matrix}\right\}N = HI + \left\{\begin{matrix}CH_3\\H\\H\end{matrix}\right.N$$

$$2.\quad CH_3I + \left.\begin{matrix}CH_3\\H\\H\end{matrix}\right\}N = HI + \left\{\begin{matrix}CH_3\\CH_3\\H\end{matrix}\right.N$$

$$3.\quad CH_3I + \left.\begin{matrix}CH_3\\CH_3\\H\end{matrix}\right\}N = HI + \left\{\begin{matrix}CH_3\\CH_3\\CH_3\end{matrix}\right.N$$

To these bodies the names of methylamine, dimethylamine, and trimethylamine were respectively given. They resemble ammonia in being volatile alkaline liquids or gases, which combine with acids to form crystallisable and well defined salts.

Hitherto, these compound ammonias have been chemical curiosities; they have, however, recently become—as has so often been the case in other instances—of great commercial importance, and are now manufactured on a large scale.

We are all well aware that the French beet-root sugar industry is one of great magnitude, and that it has been largely extended in late years. In this industry, as in the manufacture of cane-sugar, large quantities of molasses or treacle remain behind after the whole of the crystallisable sugar has been withdrawn. These molasses are invariably employed to yield alcohol by fermentation. The juice of the beet, as well as that of the sugar-cane, contains, in addition to the sugar, a large quantity of extractive and nitrogenous matters, together with considerable quantities of alkaline salts. In our sugar-producing colonies, the waste liquors or spent-wash from the still—called *vinasses* in French—are wastefully and ignorantly thrown away instead of being returned to the land as a fertiliser, and thus the soil becomes impoverished.

In France it has long been the custom of the distiller to evaporate these liquors (*vinasses*) to dryness, and calcine the mass in a reverbatory furnace, thus destroying the whole of the organic matter but recovering the alkaline salts of the beet-root. In this way 2,000 tons of carbonate of potash are annually produced in the French distilleries. More than thirty years ago the idea was entertained of collecting the ammonia-water, tar, and oils which are given off when this organic matter is calcined, but the practical realisation of this project has only quite recently been accomplished, and a most unexpected new field of chemical industry thus opened out through the persevering and sagacious labours of M. Camille Vincent, of Paris.

The following is an outline of the process as carried out at the large distillery of Messrs. Tilloy, Delaune, and Co., at Courrières. The spent-wash, having been evaporated until it has attained a specific gravity of 1·81, is allowed to run into cast-iron retorts, in which it is submitted to dry distillation. This process lasts four hours, the volatile products pass over, whilst a residue of porous charcoal and alkaline salts is left behind in the retort. The gaseous products given off during the distillation are passed through coolers, in order to condense all the portions which are liquid or solid at the ordinary temperature, and the combustible gases pass on uncondensed, and to serve as fuel for heating the retorts.

The liquid portion of the distillate is a very complex mixture of chemical compounds resembling, in this respect, the corresponding product in the manufacture of coal-gas. Like this latter, the liquid distillate from the spent-wash may be divided into—1. The ammonia water; 2. The tar. The ammonia water of the vinasses resembles that of the coal-gas manufacture, in so far as it contains the carbonate, sulphydrate, and hydrocyanide of ammonia; but it differs from this (and approximates to the products of the dry distillation of wood) by containing, in addition, methyl alcohol, methyl sulphide, methyl cyanide, many of the members of the fatty acid series, and, most remarkable of all, *large quantities of the salts of trimethylamine*.

The tar, on redistillation, yields more ammonia water, a large number of oils, the alkaloids of the pyridene series, solid hydrocarbons, carbolic acid, and lastly, a pitch of fine quality.

The crude alkaline aqueous distillate is first neutralised by sulphuric acid, and the saline solution evaporated, when crystals of sulphate of ammonia are deposited, and these, after separating and draining off, leave a mother-liquor, which contains the more soluble sulphate of trimethylamine. During the process of

[1] Lecture given at the Royal Institution by Prof. Roscoe, LL.D., F.R.S., February 21, 1879. Revised by the Author.

concentration, vapours of methyl alcohol, methyl cyanide and other nitriles, are given off, these are condensed and the cyanide used for the preparation of ammonia and acetic acid by decomposing it with an alkali.

Trimethylamine itself is at present of no commercial value, though we are not without hopes that a useful employment for this substance may soon be found. The question arises as to how this material can be made to yield substances capable of ready application in the arts. This problem has been solved by M. Vincent in a most ingenious way. He finds that the hydrochlorate of trimethylamine, when heated to a temperature of 260°, decomposes into (1) ammonia, (2) free trimethylamine, and (3) chloride of methyl :—

$$3NMe_3HCl = 2NMe_3 + NH_3 + 3MeCl.$$

By bubbling the vapours through hydrochloric acid, the alka-

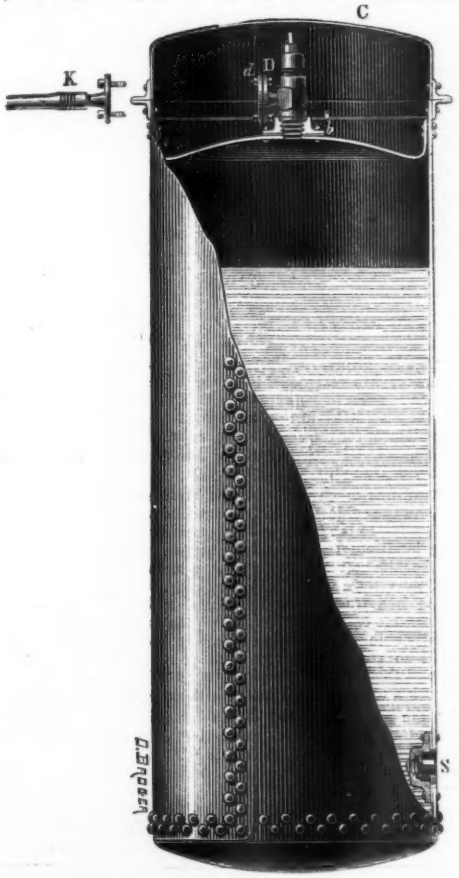

FIG. 1.

line gases are retained, and the gaseous chloride of methyl passes on to be purified by washing with dilute caustic soda and drying with strong sulphuric acid. This is then collected in a gas-holder, whence it is pumped into strong receivers and liquefied. The construction of one of these is shown in Fig. 1. They consist of strong wrought-iron cylinders, tested to resist a pressure of 20 kilos per square centimeter, and containing 50, 110, or 220 kilos of chloride of methyl. The liquid is drawn from these receivers by opening the screw tap (D), which is covered by a cap (C) to prevent injury during transit.

Both ammonia and chloride of methyl are, however, substances possessing a considerable commercial value. The latter compound has up to this time, indeed, not been obtained in large quantities, but it can be employed for two distinct purposes —1. It serves as a means of producing artificial cold. 2. It is most valuable for preparing certain methylated dyes, which are at present costly, inasmuch as they have hitherto been obtained by the use of methyl iodide, an expensive substance.

Methyl chloride was discovered in 1840 by MM. Dumas and Peligot, who obtained it by heating a mixture of common salt, methyl alcohol, and sulphuric acid. It is a gas at the ordinary temperature, possesses an ethereal smell and a sweet taste, and its specific gravity is 1·738. It is somewhat soluble in water (about 3 volumes), but much more in acetic acid (40 volumes), and in alcohol (35 volumes). It burns with a luminous flame tinged at the edges with green, yielding carbonic and hydrochloric acids. Under pressure, methyl chloride can readily be condensed to a colourless, very mobile liquid, boiling at −23 C. under a pressure of 760 mm. As the tension of the vapour is not high, and as it does not increase very rapidly with the temperature, the liquefaction can be readily effected, and the collection and transport of the liquefied chloride can be carried on without danger. The following table shows the tension of chloride of methyl at varying temperatures :—

At 0°	the tension of	CH_3Cl	is 2·48	atmospheres.
,, 15°	,,	,,	4·11	,,
,, 20°	,,	,,	4·81	,,
,, 25°	,,	,,	5·62	,,
,, 30°	,,	,,	6·50	,,
,, 35°	,,	,,	7·50	,,

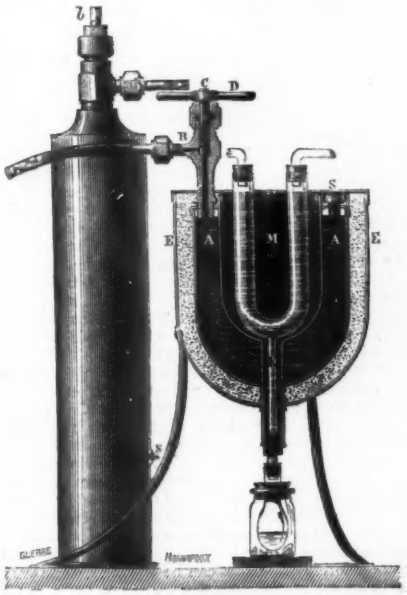

FIG. 2.

From these numbers we must of course subtract 1 to obtain the pressure which the vapour exerts upon the containing vessel.

As a means of producing low temperatures chloride of methyl will prove of great service both in the laboratory and on a larger industrial scale. When the liquid is allowed to escape from the receiver into an open vessel, it begins to boil, and in a few moments the temperature of the liquid is lowered by the ebullition below −23°, the boiling-point of the chloride. The liquid then remains for a length of time in a quiescent state, and may be used as a freezing agent. By increasing the rapidity of the evaporation by means of a current of air blown through the liquid, or better, by placing the liquid in connection with a good air-pump, the temperature of the liquid can in a few minutes be reduced to −55°, and large masses of mercury easily solidified.

The construction of a small copper receiver and of the freezing-machine employed by M. Camille Vincent is shown in Fig. 2. It consists of a double-cased copper vessel, between the two sides of which the methyl-chloride is introduced. The central space is filled with some liquid such as alcohol, incapable of solidification. The chloride of methyl is allowed to enter by the screw-tap (B), and

the screw (s) left open to permit of the escape of the gas. As soon as the whole mass of liquid has been reduced to a temperature of − 23° the ebullition ceases, the screw (s) may be replaced, and if a temperature lower than − 23° be required the tube (B) placed in connection with a good air-pump. By this simple means a litre of alcohol can be kept for several hours at temperatures either of − 23° or − 55°, and thus a large number of experiments can be performed for which hitherto the expensive liquid nitrous oxide or solid carbonic acid was required.

M. Camille Vincent has recently constructed a much larger and more perfect and continuous form of freezing-machine, in which, by means of an air-pump and a forcing-pump, the chloride of methyl is evaporated in the freezing-machine, and again condensed in the cylinders. This enlarged form of apparatus will probably compete favourably with the ether- and sulphurous acid freezing-machines now in use, as they can be simply constructed, and as the vapour and liquid employed does not attack metal, is non-poisonous, and as the frigorific effects which it is capable of producing are most energetic.

The second and perhaps more important application of methyl-chloride is to the manufacture of methylated colours.

It is well known that rosaniline or aniline red, $C_{20}H_{19}N_3$, yields compounds possessing a fine blue violet or green colour, when a portion of the hydrogen has been replaced by the radicals, methyl or ethyl, and the larger the proportion of hydrogen replaced, the deeper is the shade of violet produced. Then we have triethyl rosaniline, or Hofmann's[1] violet, $C_{20}H_{16}(C_2H_5)_3N_3$.

By the replacing one or two atoms of the hydrogen of aniline by methyl, and by oxidising the methyl-aniline, Charles Lauth obtained fine violet colours, whilst about the same time Hofmann observed the production of a bright green colouring matter now known as iodine green, formed during the manufacture of the violet, and produced from this latter colour by the action of methyl-iodide.

In order to prepare aniline green from the pure chloride of methyl a solution of methyl-aniline violet in methyl-alcohol is placed in an iron digester, and the liquid rendered alkaline by caustic soda. Having closed the digester, a given quantity of liquid chloride of methyl is added by opening a tap, and the digester thus charged is placed in a water bath, heated by a jet of steam until the temperature reaches 95°, and the indicated pressure amounts to from 4 to 5 atmospheres. As soon as the reaction is complete the hot water is replaced by cold, and the internal pressure reduced by opening the screw-tap of the digester. The product of this reaction, heated and filtered, yields the soluble and colourless base, whose salts are green. To the acidified solution a zinc-salt is added to form a double salt, and the green compound is then precipitated by the addition of common salt. By adding ammonia to a solution of the methyl green salt, a colourless liquid is obtained in which cloth mordanted with tannic acid and tartar-emetic becomes dyed green (R. S. Dale).

If rosaniline be substited for methyl-aniline in the preceding reaction, Hofmann's violet is obtained. The application of methyl-chloride to the preparation of violets and greens is, however, it must be remembered, not due to M. Vincent; it has been practised for some years by various aniline colour makers. M. Vincent's merit is in establishing a cheap method by which perfectly pure chloride of methyl can be obtained, and thus rendering the processes of the manufacture of colours much more certain than it has hitherto been. By the use of this material the aniline can be methylated in simple cast-iron boilers heated by steam, and under a pressure much more moderate than is otherwise required.

In reviewing the new chemical industry of the beet-root vinasses one cannot help being struck by the knowledge and ability which have been so successfully expended by M. Camille Vincent, on the working out of the processes. Here again we have another instance of the utilisation of waste chemical products and of the preparation on a gigantic scale of compounds hitherto known only as chemical rarities. All those interested in the progress of scientific research must congratulate M. Camille Vincent on this most successful issue of his labours.

ILLUMINATION IN SPECTROSCOPY[2]

AFTER having shown how intrinsic brilliancy of the light operated on was the chief visual step to excellence in spectroscopic observations, the author proved that the temperature of the light must be kept constant, or we might be landed in a totally different class of physical phenomena of a most confounding character.

Coming, then, practically to *flame*-spectroscopy, he described the results hitherto obtained by all the leading spectroscopists respecting the peculiar lines and bands, all of them very faint, of the blue-grey blowpipe flame of coal-gas and common air; and then showed how, by merely looking at one and the same flame *end-on*, in place of transversely, according to the usual custom, all the features hitherto chronicled may be seen some five times brighter; while many other details not dreamt of before come into view, and the temperature remains undisturbed.

Next applying the same principle to the electric-spark illumination of gas-vacuum tubes, a still greater proportional improvement was obtained. But not until the author had invented or arranged a new description of such tubes, which rendered the application of the end-on principle possible. Examples of these new tubes, as prepared lately for the author by M. Salleron, 24, rue Pavée au Marais, Paris, were exhibited; and several proofs of their superior brightness of illumination were given. The last being that in a narrow and critical region of a rather faint and difficult carbonaceous spectrum, where the Royal Society, London, has published eight lines only, and those dark ones—the new tubes showed thirty-one lines, and all of them bright ones. As yet the author had only been able to get twelve different gases thus prepared; but with such decided improvement of spectroscopic vision in every case, that he hopes so increased a demand may soon flow in upon M. Salleron, as will make it worth his while to prepare similar end-on tubes of all known volatile products; and the result can hardly but prove most favourable to the progress of spectroscopic science.[1]

[1] Hofmann, *Proc.* Roy. Soc., xiii. 13 (1863).

[2] Abstract of paper upon "End-on, in Place of Transverse, Illumination in Private Spectroscopy," by Mr. Piazzi Smyth, Past President of R. Sc. Soc. Arts. Edinb., February 10, 1879.

[1] Tubes similar to those referred to are already well-known in England: Dr. Monckhoven has in fact pointed out the value of such tubes, and sent specimens to several observers in England.—Ed.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

DR. J. H. BALFOUR, Professor of Botany in the Edinburgh University, has resigned his chair, which he has filled since 1845, on account of failing health. The patronage of the Chair of Botany is vested in the curators of the University. Among the candidates for the chair, we learn, are Mr. Carruthers, Prof. Dickson, of Glasgow, Mr. J. Bailey Balfour, and Prof. McNab, of Dublin.

THERE was much fine talk last Wednesday at the Mansion House on the subject of University extension in London, and it was pleasing to see a prince take an apparently genuine interest in the intellectual advancement of the people. We sincerely hope that the movement may lead to a substantial and durable result, though we very much doubt it. What we want most in London is a true university after the German model, not a "Cambridge extension." We are glad that Prince Leopold, in his really able address at the Birkbeck Institution on Tuesday, insisted so strongly on the weak point of the British workman, and that he can only hope to hold his own by the side of the foreign workman by starting with an equally good education.

AT the annual meeting of the trustees of the Birmingham Science College, under the presidency of the founder, Sir Josiah Mason, who celebrated on Monday his eighty-fourth birthday, it was announced that the college building, a handsome Gothic structure in the rear of the Birmingham Town Hall, is rapidly approaching completion, and the formal opening will probably be made on the founder's next birthday. Nearly 150,000*l.* has been expended on the college building and endowment.

SCIENTIFIC SERIALS

American Journal of Science and Arts, February.—We have here two interesting papers on acoustics. Mr. Jacques has inquired into the velocity of loud sounds, measuring the velocity at different short distances from a cannon by means of a series of membranes electrically connected with a chronograph. He finds that the velocity of sound is a function of its intensity, and that experiments in which a cannon is used contain an error, probably due to the bodily motion of the air near the cannon. Immediately in the rear of the cannon the velocity was less than at a distance, but, going from the cannon, the velocity rose to a maximum considerably above the ordinary velocity, and then fell gradually to the rate usually received. When the cannon was pointed

at right angles to its first position, the maximum velocity came nearer it, and had the cannon been pointed towards the membranes, the retardation would probably have become an acceleration.—Dr. Ihlseng has measured the velocity of sound in wood, both by Kundt's method and the graphic method, in which latter a blackened glass plate was drawn rapidly in a horizontal direction (across the direction of the rod's length), by a falling weight, and a pen attached to the rod wrote its vibration on the plate, which also registered those of a tuning-fork. This method was found one of considerable accuracy. Its results were slightly below those by Kundt's method, and (when the plate was moved in a different direction) it demonstrated the existence of transverse along with longitudinal, and gave their ratios.—Mr. Pumpelly writes on the relation of secular rock disintegration to loess, glacial drift, and rock basins; Mr. Fontaine continues his notes on the mesozoic strata of Virginia; and Mr. Hawes describes a group of dissimilar eruptive rocks in Compton, New Hampshire.—In a method of determining dip, devised by Mr. Hodges, a compound bar is used consisting of two joined at right angles at a point near their ends; when placed so that the two branches make equal angles with the line of dip, the two joined poles neutralise each other, and any needle suspended near that point is unaffected. A slight turning of the compound bar renders the field round the needle a north or a south, and the needle moves correspondingly.—Some notices of recent American earthquakes are furnished by Prof. Rockwood, Jun.

Journal de Physique, January.—This number opens with M. Joubert's researches on the rotatory power of quartz and its variations with the temperature; they prove that quartz constitutes a thermometer of extreme sensibility.—A new and simple regulator of velocity, for electric motors especially, described by M. Deprez, rests on the principle of centrifugal force acting on one end (loaded) of a flexible metallic strip, and (with a certain intensity) breaking contact of an adjusting screw at that end with a metallic piece, and so stopping a current which actuates the motor.—M. Witz studies the thermal effects of the walls of an inclosure on the gases it contains.—M. Pellat describes an apparatus for effecting the synthesis of compound colours, the very colours of the spectrum being taken in the desired proportions and mixed completely; and M. Schwedoff one for studying the vibratory movements of cords, the cord being set in motion by means of an electric trembler at one end.

THE *Sitzungsberichte der naturwissenschaftlichen Gesellschaft Isis in Dresden* (1878, part 1, January to July) contain the following papers of interest:—On Heligoland and Norderney from a geological point of view, by C. D. Carstens.—On the tertiary flora of the Klein Purberg near Czernowitz, by Herr Engelhardt.—On amber, by Dr. O. Schneider.—On the saltpetre and the guano from the Atakama Desert, by Herr Weis.—On fossil man, by Herr Engelhardt.—On some prehistoric remains discovered on the Hradischt in Bohemia, by W. Osborne.—On palm leaves, by Herr von Biedermann.—On the largest elm tree of Germany, by C. F. Seidel. The tree in question stands in the village of Schimsheim near the railway station of Armsheim in Rhenish Hessen, and measures 30 metres in height, its trunk 15·07 metres in circumference, while its age is estimated at close upon 600 years.—On the colour which a gas flame assumes in the vapour generated by a mixture of permanganate of potash and sulphuric acid, by Carl Bley.—On the formation of crude coralline and of resorcine-oxaleïne, by Dr. Schmitt.—On the action of ethyl mercaptan on diazo-compounds, by the same.—On a curious occurrence of tape-worms, by Herr Ebert.—On a Chinese work on insects, by C. F. Seidel.—On the origin of organic life upon the earth, by Dr. Steil.—On the red gneiss near Freiberg in Saxony, by Dr. Geinitz.—On the natural history of the Caucasus countries, by Dr. Oscar Schneider.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, January 30.—"On the determination of the Rate of Vibration of Tuning Forks," by Herbert McLeod, F.C.S., and George Sydenham Clarke, Lieut. R.E. Communicated by Lord Rayleigh, F.R.S.

The paper contains a description of some experiments made with a view to determine the absolute pitch of tuning forks by means of a method proposed by the writers in a previous paper (*Proc.* Roy. Soc., 1877, xxvi. 162).

It commences with a description of the time-measurer adopted, consisting of a compensated pendulum, worked by electricity, the impulse being given by a driver depending for its action on gravity alone. The pendulum is arranged to give second contacts, driving a clock-wheel with sixty teeth. This wheel has a platinum pin giving minute contacts, but it is used merely as a switch, the circuit being closed by the pendulum itself. The current works a relay, and closes the circuit required.

The tuning-fork apparatus consists of a brass drum resting on friction-wheels, and driven by a weight and train. Uniformity of motion being of great importance, an air-regulator, consisting of a fan inclosed in the lower compartment of a cylindrical box, is employed. By means of a diaphragm and vanes the fan can be made to do more or less work by pumping air from the lower into the upper compartment. The fan spindle carries a pulley driven by a thread passing round the drum.

Round one end of the drum are wrapped strips of paper on which white equidistant lines have been so ruled that they are parallel to the axis of the drum when the strips are in position. The strip most frequently used has 486 lines round the complete circumference of the drum. Opposite this graduated strip is placed a microscope with its axis horizontal. In the substage is placed a 2″ objective, producing an image of the graduations at the focus of the object-glass of the instrument. At the common focus of the two lenses is placed the tuning-fork, the stem of which is held vertical in a vice. The fork is partially inclosed in a glass case, and is so adjusted that the image of one of its limbs seems to cut the image of the graduations at right angles. The fork is set in motion by a suspended double-bass bow. If, when the fork is in vibration the drum is made to rotate with such a velocity that one of the graduations passes over the interval between two adjacent graduations in the time of one vibration of the fork, a stationary wave is seen of length equal to the length of that interval. To determine the number of vibrations of the fork in a given time, it is only necessary, therefore, to be able to count the number of graduations which pass in that period. As a perfectly uniform rotation has not been obtained, a regulator under the control of the operator is employed. This consists merely of a piece of string which passes round the axis of the drum, and also round a pulley which can be turned by the operator's left hand. An upward or downward motion of the wave denotes that the drum is going too fast or too slow, and by means of the pulley a gentle check or acceleration sufficient to keep the wave steady is given to the drum.

An electric counter gives the number of complete revolutions accomplished by the drum in any given period, and a fine-pointed tube, containing magenta, is carried by a saddle above the drum, and being actuated by an electro-magnet, makes a dot on a piece of white paper wrapped round the drum at the beginning and end of the experiment. The distance apart of these dots gives the additional fraction of a revolution accomplished by the drum during the period of the experiment. Electric circuits are so arranged that a reverser turned a few seconds before the minute at which it is intended to begin the experiment, causes a current to be sent exactly at that minute by the clock relay, which starts the electric counter, and also makes a dot on the drum. Just before the expiration of the last minute of the experiment the reverser is turned in the opposite direction, and at the expiration of that minute the counter is stopped, and a second mark made on the drum.

Some of the results obtained with different forks are given.

The results of further experiments made to determine the effect of temperature, of continuous and intermittent bowing, and of the mode of fixing the fork are appended.

An optical method by whi h two slightly dissonant forks may be compared without altering the period of either, is described.

Figures and diagrams fully explaining the apparatus employed accompany the paper.

February 13.—"Note on the Development of the Olfactory Nerve and Olfactory Organ of Vertebrates." By A. Milnes Marshall, M.A., D.Sc., Fellow of St. John's College, Cambridge. Communicated by W. S. Savory, F.R.S., Surgeon to, and Lecturer on Surgery at, St. Bartholomew's Hospital.

In the course of an investigation into the development of the cranial nerves of the chick, certain facts came to light indicating that the olfactory nerve, instead of being, as usually described, a structure differing totally in its mode of origin from all the other nerves in the body, in reality "exactly corresponds in mode of development with the other cranial nerves, and with the posterior roots of the spinal nerves."[1]

[1] *Proc.* Roy. Soc, March 8, 1877, p. 50, and *Quarterly Journal of Microscopical Science*, January, 1878, pp. 17-23.

The present paper contains the results of further investigations on this point; it deals also with some features in the development of the vertebrate olfactory organ, and with certain questions of a more general nature affected by the conclusions arrived at.

The Development of the Olfactory Nerve

The olfactory nerve of an adult vertebrate is usually described as consisting of three parts—a proximal *tractus olfactorius*, an intermediate *bulbus olfactorius*, and a distal *nervus olfactorius*, connecting the bulb with the olfactory organ. Of these parts the two former are commonly said to arise as a hollow diverticulum of the cerebral hemisphere—the so-called olfactory vesicle or olfactory lobe. The third part, the *nervus olfactorius*, is described as arising at a later stage either from the olfactory lobe, from the olfactory organ, or from the intervening mesoblast. In consequence of these peculiarities in its mode of development, the olfactory nerve is said not to bear the slightest resemblance to the other cranial nerve, and to be in no way comparable with them. Dr. Marshall, however, finds, from an examination of a large number of vertebrate embryos—chick, dogfish, salmon, trout, axolotl, frog, and lizard—that the *nervus olfactorius* is the first part to be developed; that it arises at the same time as the other cranial nerves and in the same manner; that it appears before the cerebral hemispheres, and consequently arises from the original fore-brain. He finds further that there is no trace whatever of an olfactory vesicle in the chick till the end of the seventh day, or in the dogfish till stage O of Balfour's nomenclature; in the salmon and trout there is no trace of an olfactory vesicle up to the time of hatching, nor indeed, for some time afterwards. Mr. Marshall maintains that the olfactory vesicle must therefore be regarded as a structure of merely secondary importance; and that the olfactory nerves, since in their early stage they do not differ embryologically in any respect from the segmental cranial nerves, must be regarded as the first or most anterior pair of true segmental nerves.

The Development of the Olfactory Organ

This will, in the absence of figure, be treated very briefly; those points only being noticed which are of special interest in connection with the conclusions arrived at in the preceding part of the paper.

The olfactory pits appear at almost the same time as the visceral clefts; or, to speak more accurately, they first become conspicuous objects at, or very shortly after, the time when the anterior visceral clefts become open to the exterior. This occurs about stage K in the dogfish, and about the fiftieth hour in the chick.

In their early stages the olfactory pits present a striking resemblance to the visceral clefts in position, shape, size, and general relations; their external apertures elongate and become slit-like, and the direction of the slit, like that of the visceral clefts, is at right angles to the longitudinal axis of the head. These facts are best illustrated by the study of whole embryos, and of longitudinal vertical sections.[1] They come out with great clearness in all the types of vertebrates examined, but with especial distinctness in the axolotl and salmon.

The development of the Schneiderian folds presents several points of great interest, which can be most favourably studied in the elasmobranchs. Attention has already been directed by Balfour[2] to the very early appearance of these folds. The important point, so far as the present question is concerned, is that these Schneiderian folds appear at the same time as, or very shortly after, the first rudiments of the gills. In addition to this identity in time, there is also identity in structure; in both cases development consists in the formation of a series of equal, closely apposed folds, mainly epithelial, but involving the underlying mesoblast to a certain extent. These folds are in the two cases—gills and Schneiderian folds—of the same width, the same distance apart, have epithelium of the same thickness and same histological character, involve the mesoblast to exactly the same extent, and in exactly the same manner; in a word, are structurally identical.

In the later stages the Schneiderian folds, like the gills, receive a very abundant supply of blood-vessels; and the relations of these vessels to the folds, which are very peculiar and characteristic, are identical in the two cases. Even in the adult elasmobranch there is a remarkable histological resemblance between the gills and the nose.

The facts above recorded concerning the development of the olfactory nerve and olfactory organ point towards the same conclusions as to the morphology of these structures, viz., that the olfactory organ is a visceral cleft; that the olfactory nerve is the segmental nerve supplying that cleft in a manner precisely similar to that in which the hinder clefts are supplied by their respective nerves; and that the Schneiderian folds are gills.[1]

These conclusions, if accepted, will considerably simplify our conception of the segmentation of the vertebrate head. As there are no nerves or clefts in front of the olfactory segment, the olfactory nerve must be taken as the most anterior nerve, and the nose as the most anterior cleft. The next cleft is that in front of the maxillo-palatine arch, of which a part probably persists in the adult as the lachrymal duct: the segmental nerve corresponding to this cleft is the *third*, or oculomotor nerve. Next comes the mouth cleft, supplied by the *fifth*, or trigeminal nerve; and then in succession the clefts supplied by the facial, glossopharyngeal, and pneumogastric nerves. This view of the constitution of the vertebrate head is found to accord well with the later researches of Prof. Parker on the morphology of the skeletal elements of the head.

Some at least of the labial cartilages will probably prove, on this view, to be homologues of the extrabranchials, a comparison that has already been made by Prof. Parker.[2]

If the olfactory organs are visceral clefts, they must originally have communicated with the mouth cavity. Indications of a former connection of this kind are by no means wanting; thus in salmon embryos the alimentary canal extends forwards, so as to underlie the nasal sacs; as development proceeds, this anterior prolongation of the mouth cavity gradually shrinks; it persists for a short time as a pair of cæcal diverticula, which ultimately disappear altogether.

In conclusion, it may be noted that the Schneiderian folds afford an instance, on the theory here maintained, of structures originally hypoblastic in nature becoming, from changed circumstances, epiblastic.

"On an Extension of the Phenomena discovered by Dr. Kerr and described by him under the title of 'A New Relation between Electricity and Light.'" By J. E. H. Gordon, B.A., Assistant Secretary of the British Association. Communicated by Prof. Tyndall, F.R.S.

In November, 1875, Dr. Kerr announced in the *Philosophical Magazine*, that he had discovered a new relation between electricity and light. He showed that when glass is subjected to an intense electrostatic stress that a strain is produced which causes the glass to act like a crystal upon polarised light.

On Wednesday, February 5, 1879, I was working at this experiment in the Royal Institution, and endeavouring, by means of the electric light, to project the effect on a screen, in preparation for a lecture on the next day.

In the experiment as described by Dr. Kerr, and which was shown plainly on the screen, on February 6, the light is extinguished by the Nicols, and reappears when the coil is set going.

In the projection experiment a patch of moderately bright white light, about 3 inches diameter, appeared on the screen when the coil was worked. The images of the points inside the glass were about 1½ inches apart. On Wednesday, however, the electrostatic stress was accidentally allowed to become strong enough to perforate the glass. Immediately before perforation there occurred the effects which are the subject of the present communication.

First appeared a patch of orange-brown light about six or seven inches diameter. This at once resolved itself into a series of four or five irregular concentric rings dark and orange-brown, the outer one being perhaps fourteen inches diameter. In about two seconds more these vanished and were succeeded by a huge black cross about three feet across, seen on a faintly luminous ground. The arms of the cross were along the planes of polarisation, and therefore (the experiment being arranged according to Dr. Kerr's directions) were at 45° to the line of stress.

The glass then gave way, and all the phenomena disappeared except the extreme ends of the cross, and the discharge through the hole, where the glass had been perforated, was alone seen.

The phenomena were seen by Mr. Cottrell, by Mr. Valter (the second assistant), and by myself. A fresh glass plate was

[1] For figures of whole embryos illustrating the points referred, *vide* Parker, "On the Structure and Development of the Skull in Sharks and Skates," *Trans.* Zool. Soc., vol. x. part iv., 1878; Pl. 25, Fig. 1; Pl. 39, Figs. 1 and 2; Pl. 40, Fig. 1; and Balfour, *op. cit.*, Pl. 7, Stage L.

[2] *Op. cit.*, p. 184, and Pl. 44, Fig. 14.

[1] Cf. Dohrn, "Ursprung der Wirbelthiere," p. 23.

[2] *Proc.* Zool. Soc., vol. x. part iv., 1878, p. 212.

at once drilled in hopes of repeating the phenomena in the lecture next day, but owing to sparks springing round we did not succeed in perforating the glass, and therefore saw only the faint return of light described by Dr. Kerr.

Some more glasses have been prepared and their terminals insulated, and I now propose to make another attempt to repeat the new effects before the Royal Society.

Zoological Society, February 18.—Prof. W. H. Flower, F.R.S., president, in the chair.—The Secretary exhibited, on behalf of the Rev. T. O. Morris, an example of *Bombyx quercûs* with malformed antennæ.—Mr. Sclater exhibited a new humming bird from Northern Peru, which he had received for identification from M. L. Taczanowski, C.M.Z.S., and which he proposed to name *Thaumatius taczanowskii*.—Mr. Sclater exhibited a living amphisbænian (*Bronia brasiliana*) lately received by the Society from Monte Video.—A communication was read from Mr. E. L. Layard, C.M.G., F.Z.S., containing a note on *Pachycephala icteroides*, Peale, with the description of a supposed new species of the genus from Ovalau, Fiji group, proposed to be called *P. neglecta*.—A communication was read from Dr. A. Günther, F.R.S., containing a description of four new species of chameleons from Madagascar, proposed to be called *Ch. malphe*, *Ch. brevicornis*, *Ch. gularis*, and *Ch. globifer*.—A communication was read from Mr. Edgar A. Smith, F.Z.S., containing a description of a large collection of mollusca from Japan, formed by Capt. H. C. St. John, R.N., of H.M.S. *Sylvia*.—Messrs. Godman and Salvin read descriptions of a number of new species of butterflies from Central and South America.—A second communication from the same authors gave an account of a collection of butterflies made by the Rev. G. Brown in New Ireland and New Britain.—Mr. A. G. Butler gave an account of the Heterocera contained in a collection from the same locality.—A communication was read from Mr. W. A. Forbes on the systematic position of the genus *Lathamus*, in which, from a study of its pterylosis, osteology, and other points in its external and internal structure, he showed that this parrot must be referred to the neighbourhood of the *Platycercidæ*.—Mr. R. Bowdler Sharpe read a note on *Heliodilus soumagnei*, Grandidier, of which a specimen had recently been acquired by the British Museum.—Mr. Sharpe likewise pointed out the characters of a second species of the genus *Dromæocercus*, from Madagascar, proposed to be called *D. seebohmi*.—A communication was read from Mr. A. Boucard, C.M.Z.S., containing descriptions of two supposed new species of South American birds.—Dr. F. Day read some remarks on the occurrence at Southend of the little gurnard, *Trigla paciloptera*.

Meteorological Society, February 19.—Mr. C. Greaves, president, in the chair.—Eleven new Fellows were elected and thirteen candidates proposed.—The following papers were read:—Diurnal variations of barometric pressure in the British Isles, by Frederick Chambers. The object of this paper is to show that differences of types of the diurnal variations of pressure at inland or sea-coast stations are due to the superposition, on a common type of diurnal variation at all the stations, of a distinct diurnal variation of barometric pressure, such as is required to satisfy the convection-current theory which explains the well-known diurnal land and sea breezes. To show this, all that is necessary is to take the differences of the corresponding hourly inequalities of the barometric pressure at pairs of inland and coast stations, and to exhibit these differences in the form of curves, which are then found to closely resemble the curves of diurnal variation of air temperature.—On a standard cistern siphon barometer, by Frederick Bogen.—On the relation existing between the duration of sunshine, the amount of solar radiation, and the temperature indicated by the black bulb thermometer in vacuo, by G. M. Whipple, B.Sc., F.R.A.S. The author has instituted a comparison between the duration of sunshine, as determined by Campbell's sunshine recorder, and the amount of solar radiation, as ascertained from the readings of the black bulb thermometer in vacuo, for the year 1877, at the Kew Observatory. It is evident that there is a close relation between these phenomena, but owing to the great range of the black bulb thermometer, the exact nature of the connection is not immediately evident. The author says that it may be safely concluded that the measure of solar radiation as given by the black bulb thermometer is only to be considered at any place as an indication of the relative presence or absence of cloud from the sky at the locality, and so its use as a meteorological instrument may with advantage be set aside in favour of the sunshine record, which has not the elements of uncertainty attached to it, inseparable from the former instrument.—Results of meteorological observations made at Buenos Ayres, by William B. Tripp, Assoc. Inst. C.E.

Anthropological Institute, February 11.—Prof. W. H. Flower, LL.D., F.R.S., vice-president, in the chair.—The election of Sir Henry Sumner Maine, K.C.S.I., LL.D., F.R.S., as a Member, was announced.—Prof. W. H. Flower, LL.D., F.R.S., exhibited and described a scaphocephalic cranium from Fiji, and Mr. A. L. Lewis exhibited a series of implements and photographs from Australia.—Mr. John E. Price read a paper on the Australian Aborigines, by Mr. D. Macallister. After describing their social and domestic observances, traditions, and religious notions, the author concluded that he had no doubt that had the continent of Australia remained undiscovered by Europeans for a few thousand years longer, the climatic and general physical changes which would doubtless have occurred, together with the contact at intervals with their more civilised Polynesian neighbours, would have constituted an environment more favourable to progress than any which has ever existed, and would have tended to an improved condition of the people. As it was, the total absence from the continent of ferocious or powerful animals, the comparative ease with which the poor and limited quantity of their food was obtained, and their national isolation, may have been a patent cause for the non-progressive character of the people.—The director also read a paper by Capt. W. E. Armit, F.I.S., on the customs of Australian Aborigines.

Entomological Society, February 5.—Sir John Lubbock, Bart., V.P.R.S., president, in the chair.—Messrs. H. W. Bates, J. W. Dunning, and F. Smith, were nominated vice-presidents for the ensuing year.—Mr. H. J. Elwes exhibited a collection of lepidoptera from a small island at the mouth of the River Amur.—Mr. Waterhouse exhibited a remarkable spider from West Africa, *Gasteracantha Cambridgei*, Butt.—A specimen of *Harpalus oblongiusculus*, taken at Weymouth, was exhibited by Mr. Champion.—The Rev. A. E. Eaton remarked on the peculiarities in the neuration of the wings of most of the *Ephemeridæ*, and exhibited drawings of wings of *Trichoptera* and *Tinéina*, to show the homologies in the neuration of the same.—The Secretary read a note from Dr. Fritz Müller, recording a remarkable case of mimicry in the Brazilian butterfly, *Eucides pavana*, which mimics *Acræa thalia*. It is, however, in the male sex of *E. pavana* that the greatest resemblance to the *Acræa* is found.—The following papers were also communicated: On the lepidoptera of the Amazons, &c., Part iii., Noctuites, by A. G. Butler.—Description of a new genus of rhyncophorous coleoptera, &c., by C. O. Waterhouse; and descriptions of the species of the lepidopterous genus Kallima, by F. Moore.

Institution of Civil Engineers, February 18.—Mr. Brunlees, vice-president, in the chair.—The paper read was on the construction of heavy ordnance, by Mr. J. A. Longridge, M. Inst. C.E.

BOSTON

Society of Natural History, May 15, 1878.—The Devonian brachiopoda of the Province of Para, Brazil, by R. Rathbun, late assistant geologist to the Geological Commission of Brazil.

PHILADELPHIA

Academy of Natural Sicences, November 5, 1878.—Descriptions of Ichneumonidæ, chiefly from the Pacific slope of the United States and British North America, by E. T. Cresson.

November 12.—Descriptions of a new species of Delabella from the Gulf of California, with remarks on other species, by R. E. C. Stearns.

November 26.—On the structure of the gorilla, by Dr. Chapman, dealing with the muscles of the extremities as found in a male of two years old.

BERLIN

Chemical Society, February 10.—At the close of Prof. Kopp's remarks (see p. 387), Herr Frank exhibited a mass of infusorial earth saturated with bromine. As this form of silica will take up eight or ten times its own weight of bromine, he claimed that this would be a convenient form of handling, weighing, and using this corrosive liquid. The speaker also stated that he had found petroleum to be a specific for the burns and stains of bromine.—Herr Baumann then exhibited a specimen of hydroquinon found in the form of hydroquinon-sulpho acid in

the urine of a dog poisoned with carbolic acid. This remarkable conversion, in the system, of a mono-phenol into a di-phenol, was less remarkable than the statement of the speaker that he had also found a compound of paracressol in the urine of a horse, where it had been produced from the ordinary food.

VIENNA

Imperial Academy of Sciences, December 19, 1878.—The following, among other papers, were read:—Explanations of some orographic and topographic details of European Turkey, not rightly understood by geographers hitherto, by Dr. Boué.—Preliminary remarks on the formation of rational plane curves on one another, by Dr. Weyr.—Researches on the relations of nutritive matters to the transpiration of plants (second series), by Dr. Burgerstein.—On some chemical constants, by Prof. Peschka.—The theory of electrotonus, by Dr. Fleischl.—On the orbit of the planet (153) Hilda, by Herr Kühnert.

January 9.—Critical researches on the species of the natural family of *Cervi* (concluded), by Dr. Fitzinger.—On direct muscle-excitation with the muscle-current, by Prof. Hering.—On the magnetic behaviour of pulverised iron, by Prof. Waltenhofen.—Spectroscopic researches, by Herr Ciamician.—Determination of coefficients of elasticity from bending of a bar, by Prof. Pscheidl.—On a new water-wheel, by Herr Kersovini.—On a new problem of ballistics, by Dr. Simony.—The daily period of the velocity and direction of the wind, by Dr. Hann.—On the action of nitrous acid anhydride on protocatechuic acid, by Dr. Gruber.

January 16.—Natural history of the Flagellata (the third part of a work on Infusoria), by Prof. Ritter v. Stein.—On Dr. Rosicky's experiments with Geissler tubes, by Prof. Mach.—On the summation of stimuli by the heart, by Prof. Ritter v. Basch.—On condensation-products of gallus acid, by Prof. Oser and Herr Böcker.—Report on the results of investigations and excavations by the prehistoric commission during the past year.

PARIS

Academy of Sciences, February 17.—M. Daubrée in the chair.—The following papers were read:—Meridian observations of small planets at the Greenwich and Paris Observatories during the fourth quarter of 1878, communicated by M. Mouchez.—Determination of the coefficient of elasticity of different substances and of their limit of elasticity, by M. Phillips. The method suggested is based, like a previous one, on the theory of a regulator spring, but the influence due to inertia of the spring is suppressed. The coefficient of M. Deville's new alloy of iridium is given.—New researches on electric fish; characters of the discharge of the gymnotus; effects of a torpedo's discharge sent through a telephone, by M. Marey. He finds the discharge of the gymnotus pretty similar to that of the torpedo, and it is similarly affected by temperature. Using the telephone, a gentle excitation of a torpedo produces a short croaking sound, each of the small discharges consisting of only a dozen fluxes, and lasting hardly $\frac{1}{10}$th of a second. But the sound from a prolonged discharge, caused by pricking the electric lobe of the brain, lasts three or four seconds, and is a kind of moan, the tonality being near *mi*, (165 vibrations).—On the project of the interior sea in Algeria, by M. Favé. The topographic levellings at Suez, on land, comparable to that of Sahara, were proved (M. Favé urges) to have sufficient exactness.—Does the didymium of samarskite differ from that of cerite? by M. Lecoq de Boisbaudran. Both, he finds, give the same three blue lines.—New spectral lines observed in substances extracted from samarskite, by the same. He finds new lines or bands (not described by MM. Delafontaine, &c.), both of emission and absorption, which correspond together (at least the principal), and belong apparently to some new body. He expresses high admiration of Prof. L. Smith's generosity in distributing to chemists in France and America, rare and arduously elaborated products which he had not completed the examination of.—On the measures taken by the Sanitary Intendance of Marseilles, in the fear of invasion by the plague, by M. de Lesseps. He argues that it is foolish and useless to hamper the commerce of Marseilles with quarantine, &c., as the disease is not contagious but infectious, spreading by emanations carried by the air; and it would not be likely to attack such a town. He points out that the plague in Lower Egypt in 1834-5 did not spread to Upper Egypt, though the communications were not interrupted. M. Bouley contended that where the plague had appeared in Western Europe, it had come by diseased persons or objects in contact with them. M. D'Abbadie thought M. Bouley too absolute in asserting that the Oriental plague always spread by contagion.—On the Foucault's top transformed into a gyroscopic pendulum, by M. Gruey.—On the determination of the number of double points of a space defined by algebraic conditions, by M. Saltel.—Application of the direct potentials of Lamé to calculation of the equilibrium of elasticity of an isotropic and indefinite homogeneous solid, solicited in a finite extent by any exterior forces, by M. Boussinesq.—On unequal propagation of light polarised circularly in bodies submitted to the action of magnetism, according to the nature of the magnetisation and the direction of the luminous vibrations, by M. Becquerel. The fact here stated he demonstrated experimentally. The displacement of interference fringes under the magnetic influence, was the criterion employed.—Researches on the compressibility of gases at high pressures, by M. Amagat. The method (in which a deep pit is resorted to has been already described. Under a pressure of 430 atmospheres (the greatest reached), the volume of nitrogen is nearly a fourth greater than that deduced from Mariotte's law; this corresponds to a difference of nearly 100 ctm. in the pressure necessary to get the reduction of volume deduced from this law.—Note on the phenomenon observed by M. Duter, by M. Korteweg.—Improvements in Harrison's electric lamp, by M. Ducretet. Apparatus inclosed in the supporting case regulates automatically the consumption of the carbons and keeps the luminous arc constant.—On the relations which unite tetric and oxytetric acids and their homologues to succinyle, malyle, and other radicals of bibasic acids, by M. Demarçay.—Bromocitraconic acid, by M. Bourgoin.—On the respiratory innervation in the poulpe, by M. Fredericq. The integrity of visceral nerves, the subœsophagean masses, and the palleate nerves, seem alone indispensable to normal production of respiratory movements.—On the functions of the ganglionic chain in decapod crustaceans, by M. Yung.—On the existence of Saigas in France in the age of the reindeer, by M. Gaudry. M. Lartet, several years ago, announced the discovery of horns of the animal, but thought these had been brought as arms by a strange people. Jaw-bones and bones of the limbs have now been found.—Geological study of strata traversed by a tunnel of 14,400 metres, for directly connecting the Fuveau basin of lignite with the sea, by M. Dieulafait.

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